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SMITHSONIAN INSTITUTION  
UNITED STATES NATIONAL MUSEUM

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## ADVERTISEMENT

The scientific publications of the National Museum include two series, known, respectively, as *Proceedings* and *Bulletin*.

The *Proceedings*, begun in 1878, are intended primarily as a medium for the publication of original papers, based on the collections of the National Museum, that set forth newly acquired facts in biology, anthropology, and geology, with descriptions of new forms and revisions of limited groups. Copies of each paper, in pamphlet form, are distributed as published to libraries and scientific organizations and to specialists and others interested in the different subjects.

The dates at which these separate papers are published are recorded in the tables of contents of each of the volumes.

The present volume is the hundred and first of this series.

The *Bulletin*, the first of which was issued in 1875, consists of a series of separate publications comprising monographs of large zoological groups and other general systematic treatises (occasionally in several volumes), faunal works, reports of expeditions, catalogs of type specimens, special collections, and other material of similar nature. The majority of the volumes are octavo in size, but a quarto size has been adapted when large plates were regarded as indispensable. In the *Bulletin* series appear volumes under the heading *Contributions from the United States National Herbarium*, in octavo form, published by the National Museum since 1902, which contain papers relating to the botanical collections of the Museum.

REMINGTON KELLOGG,  
*Director, United States National Museum.*

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A REVISION OF THE BEETLES OF THE GENUS  
MYOCHROUS

By DORIS HOLMES BLAKE

THE name *Myochrous* ( $\mu\acute{o}\varsigma$ , mouse +  $\chi\rho\acute{o}\mu\alpha$ , color) appears first in the DeJean Catalogue of 1837 (p. 438), with three specific names listed, all nomina nuda. In 1846, in the d'Orbigny Dictionary, the genus was mentioned, but it still remained a nomen nudum. Chevrolat stated that two of the three species listed were from Cayenne and one from the United States. In 1847 Erichson<sup>1</sup> adopted the name from DeJean's Catalogue and described a single species from Peru (*Myochrous immundus*), thereby validating the genus and fixing the type. In 1851 Blanchard<sup>2</sup> described four species from Chile, and in 1864 Philippi<sup>3</sup> two more from the same country. In 1856 Jacquelin DuVal<sup>4</sup> placed a Fabrician species (*Cryptocephalus dubius*), probably from St. Croix, in the genus. In 1858 Boheman<sup>5</sup> described a species collected on the voyage of the *Eugenia* at Rio de Janeiro, which he named *M. denticollis*, a name that had already been used by Say for a species of *Colaspis* from Missouri, which LeConte in 1859 assigned to *Myochrous*. Baly,<sup>6</sup> in 1865, in "an attempt at the classification of the Eumolpidae," gave a description of the subfamily Myochroini with a table of the genera, in which he included *Dictyneis*, *Myochrous*, *Glyptoscelis*, *Pachnephorus*, and *Eryxia*. To *Dictyneis*, a genus described

<sup>1</sup> Archiv für Naturg., vol. 8, p. 164, 1847.<sup>2</sup> In Gay, Historia física y política de Chile . . . , vol. 5, pp. 544-546, 1851.<sup>3</sup> Stett. Ent. Zeit., vol. 25, pp. 389-390, 1864.<sup>4</sup> In Ramón de la Sagra, Historia física, política y natural de la Isla de Cuba (Spanish ed.), vol. 7, pt. 2, pp. 124-125, 1856.<sup>5</sup> Kongliga Svenska Fregatten Eugenies Resa . . . , Insects, p. 616, 1858.<sup>6</sup> Journ. Ent., vol. 2, pp. 433-436, 1865.

in the above-mentioned article, he assigned the species of *Myochrous* described by Blanchard and Philippi, separating them from *Myochrous* because they are wingless, have the elytra soldered together at the suture, and are more gibbous and covered by tubercles. In the same year Baly<sup>7</sup> described three new species of *Myochrous*—*M. armatus* from Brazil, *M. explanatus* from Venezuela, and *M. sallei* from Mexico. Of the remaining species in the genus, two North American ones have been described by LeConte, five have been described in the *Biologia Centrali-Americana* by Jacoby, and one from Argentina by Brèthes. Recently Schaeffer has described three and Johnson one from the United States.

In 1947<sup>8</sup> I worked up the West Indian material in the Museum of Comparative Zoology and the National Museum collections, and in my study of these species I came to realize that the United States species were somewhat confused, particularly those closely related to the important economic species *M. denticollis* (Say). A Mexican species that invades southern Texas and New Mexico and a southeastern species have both gone under that name. In the *squamosus* group, furthermore, there were two other unrecognized species, and in California occurs another closely related to *M. longulus*. As for the Mexican and Central American species, nothing has been done since Jacoby's treatment of them in the *Biologia*. Many specimens of *Myochrous*, which are impossible to name because they are mostly undescribed species, are constantly being intercepted at ports of entry in shipments of fruit and vegetables. In studying the Central American species I included some South American ones, as some were common to both Central and South America. Since only five species have been described from South America, and since others were represented in both the Museum of Comparative Zoology and the National Museum collections, I have been tempted to describe the most distinct and well-marked species. Others, of which we have not sufficient material to warrant drawing up a description, I have left untouched. Undoubtedly many additional species exist throughout Central and South America that will turn up in future collections.

The genus is a difficult one because the species are so closely related. They are all similar in color, dark reddish brown or piceous black, and all are more or less densely covered by pale scales that hide the underlying sculpture, particularly that of the thorax wherein most of the differences appear. The genitalia, for the most part, are of the same general shape and in many, without close examination, seem much alike. In addition, there is considerable overlapping in the range. But after studying the material from both North and South

<sup>7</sup> Trans. Ent. Soc. London, ser. 3, vol. 2, pt. 4, p. 335, 1865.

<sup>8</sup> Blake, Proc. Ent. Soc. Washington, vol. 49, pp. 22-28, 1947.

America, I find that, as in other genera such as *Disonycha*, the species in many cases fall into fairly definite groups. As we come to know more about them, I am certain that this grouping will become even more evident. Because of the fragmentary knowledge of the genus in Central and South America the keys that I have drawn up for the species here described from those regions are bound to be inadequate. In the treatment of the Central and South American members, the species have been grouped according to apparent morphological characters rather than according to geographic distribution, insofar as it is possible.

In the United States, where I have recognized 13 species, the genus appears to be best represented in the Central and Southern States. There are two species occurring on the Pacific coast from the middle of California southward, and on the Atlantic seaboard there are three species that occur from Maryland southward. The rest are all from the central part of the country. One species, *squamosus*, ranges from the Great Plains of Canada, in Alberta and Saskatchewan, through Montana and the Dakotas south to Texas. The rest are found farther south, *movallus* and a new species in the Dakotas, *denticollis* from Iowa southward, and in Texas, the meeting point of Mexican and northern species, there are seven species.

In the Central American species the localities are too poorly indicated on most of the specimens to permit many deductions. A great many are labeled simply as found in shipments of fruit or vegetables from Mexico, Guatemala, or Honduras. In all, 11 species are recognized as occurring in Mexico and Central America. Of these, three are known to extend their range into the United States; 8 are recorded from Mexico. In the Canal Zone, where most intensive collecting has been done, 5 are known.

Two of the species found in the Canal Zone are represented in museum material from northern South America. Besides these two, there are 26 others recognized in this paper from South America. They occur from Colombia on the Pacific side down through Ecuador, Peru, and Bolivia to Chile, and on the Atlantic side from Venezuela and the Guianas, through Brazil, Paraguay, and Uruguay to Argentina.

In the West Indies the beetles have been taken in Cuba, Puerto Rico, Haiti, and Jamaica in the northern group of islands. Future collectors will probably find them on other islands. This group is quite distinct from any in North and South America. On each island is found a species closely related to but slightly different from the ones on the other islands. The specimens from the islands of Barbados, Grenada, and Trinidad belong to a species that is also found in the Guianas in South America.

*Myochrous* is one of 23 genera that are grouped together under the Myochroini and are chiefly characterized by being covered by scales or coarse hairs; in addition, the prothorax has a distinct margin, and the prosternum is lobed under the eyes. The two pairs of posterior tibiae are not emarginate except in the genus *Pachnephorus*, which in this regard unites the group with the Typophorini.

Only eight of the genera occur in the Western Hemisphere, and of these only three, *Glyptoscelis* LeConte, *Myochrous* Erichson, and *Colaspidea* Laporte, are from North and Central America. *Chalcosicya* Blake is confined to the West Indies. *Dictyneis* Baly, composed of a group of very odd wingless beetles with the elytra decorated with warts and tubercles, is known only from Chile. *Jansonius* Baly is a monotypic genus from Chile. *Trichochalcea* Baly and *Cellomius* Lefèvre are both monotypic genera from Brazil. The remainder of the group of genera is chiefly from Asia and Africa. *Pachnephorus* Redtenbacher is found also about the Mediterranean, and *Colaspina* Weise is a monotypic genus from Provence. One Australian genus, *Neocles*, Chapuis described as being the *Myochrous* of Australia. The description of the thorax with two big tubercles on the projected anterior margin together with a median sulcation sounds very much like that of the unique species *M. curculionoides* Lefèvre from northern South America.

In North America *Myochrous* comes nearest to *Glyptoscelis* and is distinguished from it by having the front tibiae and thorax usually toothed, the claws appendiculate, not bifid, and the elytra striately punctate.

*Myochrous* is composed of a fairly homogeneous lot of species. Yet in this natural group there are variations that suggest its close relationships with the other genera. For instance, some species of *Pachnephorus* occurring about the Mediterranean are not unlike some species of the *M. squamosus* group, which occur in the more arid regions of the United States. Like *Pachnephorus*, *M. squamosus* is without thoracic toothings and has broad, often bifid scales, but the shorter first abdominal segment and the lack of emargination of the hind tibiae place it definitely with *Myochrous*.

#### DESCRIPTION OF THE GENUS

From 3.5 to 9.5 mm. in length, usually stout, oblong, reddish brown, piceous, or black beetles, frequently shining with a bronzy luster when denuded of the usually dense and appressed grayish, pure white (in *M. sallei*), pale brownish, or yellowish scales that cover the entire upper surface, the lower surface less densely and more finely pubescent; beneath the scales the surface usually coarsely and the elytra striately punctate. Prothorax for the most part 3-toothed, antennae short,



not coming much below the elytral humeri and with thickened outer joints, anterior tibiae usually with an inner tooth, and posterior femora often bluntly toothed.

Head broad and rounded over the occiput, ordinarily roughly sculptured, with the punctures often in lines or wrinkles down the occiput, on each side nearly always a more pronounced ridge extending down above the eyes; frequently a depressed median line down the front; no transverse line between the eyes, the scales coming down to the antennal sockets and hiding the punctation beneath. Lower front short, the surface less scaly, with a few finer hairs, transversely placed, and the surface luster shining through; jaws large and powerful. Eyes widely separated, nearly entire, only lightly sinuate on inner side. Antennae not extending much below the humeri, very much the same throughout the genus, usually yellowish or reddish; the first and second joints swollen, second short, third a little longer than fourth, 3 to 6 more slender, 7 to 11 thicker, a little longer and hairy. Prothorax usually not so wide as the elytra, varying greatly in proportions, but most frequently wider than long and with three teeth along each side and a smaller tooth at apical and basal angles; lateral teeth varying greatly in prominence, sometimes heavy and wide, sometimes tiny, in some few cases, as often in *M. explanatus* Baly, simply an undulation of the margin; in one group (*squamosus*) these lateral teeth or angularities not pronounced and usually represented only by a rounded angle slightly behind the apical angle and sometimes another below the middle; in some groups the anterior margin produced over the head and thickened, and in one species (*M. curculionoides* Lefèvre) this thickening taking the form of two gibbosities. Upper surface of prothorax usually densely and often rugosely punctate, frequently with longitudinal ridgings, or the punctures at times dense, deep, and distinct, sometimes round, at other times elongate. Convexity and shape of the prothorax varying in different species, in some narrowly convex (*curculionoides* group), in others only moderately rounded, and in still another (*explanatus* Baly), with the margins dilated and flat; frequently a depression along the basal margin, most marked over the scutellum. Scutellum small, lightly scaly. Elytra oblong, with parallel sides and small humeri, the margin about the humeri often quite serrate, this serration in the *curculionoides* group extending all along the margin; a short intrahumeral sulcus and usually a little depression behind the basal callosity that is often on either side of the scutellum; surface densely, coarsely, and sometimes rugosely striate-punctate, with ridges or wrinkles often across the basal half; usually densely covered with scales, these scales varying greatly in size and shape, from short, broad, and closely appressed to long, curved, coarse, hairlike scales, usually at least two different kinds on

the upper surface of a single specimen, one short and inconspicuous beneath the longer and often broader outer scale. In certain species, such as *squamosus* LeConte and *rhabdotus*, new species, the scales as broad as long, and in *squamosus* with a suggestion of being bifid, as in the genus *Pachnephorus*; in other cases truncate. Body beneath usually less densely covered with finer scales especially on the mesosternum, metasternum, and abdomen, so that the surface shines through, on the sides of the prosternum the scales thicker and like those on the prothorax. Prosternum widely lobed below the eyes; punctation of the breast and abdomen, on the first segment especially, variable, from finely and sparsely punctate to coarsely, even rugosely punctate. Tip of the abdomen in the male usually with a triangular depression, in the female a deep rounded pit, though sometimes no depression whatever (*squamosus* group), and in the male only a faint one. Legs stout, not very long, shining, coarsely punctate with a scale from each puncture, the posterior femora more or less distinctly and bluntly toothed in most species; anterior tibiae usually with a tooth on the inner side near the apex, and in the male a tooth at the apex on the inner side of the tibiae of the anterior pairs of legs; in two species, the middle tibiae and, in the male, the posterior tibiae with a spur before the apex; tibiae ridged and at apex dilated, the claws appendiculate, not toothed. Aedeagus a typical eumolpid structure in outer shape, being simply curved and with a somewhat variably pointed tip, in the North American species not showing much variation except in the *squamosus* group, in which the pointed tip is exceedingly short and small, in the Central American and still more in the South American species this organ often presenting considerable differences in size and shape; in one group the tip broadly hollowed out, as a scoop; in a Trinidad species the aedeagus broad, heavy, and truncate with a tiny tip in the middle, and in a Brazilian species the tip drawn out into a long narrow point.

The groups into which the species seem to fall naturally are here arranged according to the external appearance coupled with the shape of the aedeagus. The widely distributed Mississippi Valley species, *M. denticollis* (Say), for instance, has close relatives in southern Texas and Mexico (*M. cyphus*, new species, and *M. austrinus*, new species) and farther south in southern Mexico and Central America (*M. carinatus* Jacoby and *M. melancholicus* Jacoby), the last two being larger and more coarsely punctate and in general more divergent in outward appearance, but possessing an aedeagus that is of essentially the same shape. The common species west of the Mississippi Valley from Alberta to Texas, *M. squamosus* LeConte, has three close relatives, *M. intermedius*, new species, *M. severini*, new species, and *M. pauxillus* Schaeffer, the last found only in the area around Browns-

ville, Tex. This group is unique in not having a toothed prothorax. The aedeagi of *intermedius* and *severini* are strikingly alike, and the chief differences in the group are in the scales and punctation. On the Pacific coast are two closely related species, *M. longulus* LeConte and *M. whitei*, new species, differing from the others in their slender shape and long, wide scales. About the Gulf of Mexico are three reddish-brown species, *M. floridanus* Schaeffer, which goes as far north as Virginia, *M. magnus* Schaeffer, from Texas and Mexico, and *M. tibialis* Jacoby, whose range extends from Mexico to Panama. These three also have similarly shaped aedeagi. In the northern islands of the West Indies are species from Cuba, Puerto Rico, Jamaica, and Haiti that vary a little from each other much as do the species in the *squamosus* group. From the southern islands of Barbados, Grenada, and Trinidad comes a species, *M. barbadensis* Blake, that is found in northern South America and has close relatives in Central America (*M. coenus*, new species, from Panama, and *M. femoralis* Jacoby, from farther north in Mexico, Guatemala, and Honduras). These species all have a thorax covered with round deep punctures and an aedeagus with a broad apex and a short, broadly rounded point. In Panama is a species having an aedeagus with a peculiar scooplike tip unlike any other, and in Peru and Ecuador occurs a beetle with a similar sort of structure. Externally the two beetles are very much alike in shape and in having a very densely and coarsely punctate surface. In South America, where the genus takes on unusual characters, there is a group of three species of which *M. curculionoides* Lefèvre is the most aberrant. This has two pronounced elevations on the anterior margin of the thorax that elsewhere in the group is greatly thickened. All three species differ from the others in having a narrowly convex thorax, elytra with unusually distinct basal callosities, and a pale band of scales at the apex. Still another group is composed of three small mottled species, all very much alike. The first ranges from Mexico through the Canal Zone to northern Colombia, the second is found along the northern coast of South America through the Guianas and Venezuela to Brazil, and the third occurs in Bolivia and Paraguay.

In North America there are very few species, aside from the *squamosus* group, that stand out as being very unusual. *M. ranella*, new species, with its heavy, pinched-in thorax, is mildly unique. In Central America there is more divergence in the genus. But in South America are found most strikingly different beetles, and up to the present, at least, many of them quite unlike any others. Such are *M. explanatus* Baly, the largest and flattest of the genus; *M. armatus* Baly, another large one with an extraordinarily long slender point on the aedeagus; *M. bolivianus*, new species, a queer chunky species,



*M. rhabdotus*, new species, and *darlingtoni*, new species, with distinct scale color patterns; and lastly, the type of the genus, *M. immundus* Erichson, quite unlike any other in having long, hairlike scales and almost untoothed anterior tibiae.

### LIFE HISTORY

The life history of only one species, the southern corn leaf-beetle, *M. denticollis* (Say), has been studied, and in this case over a period of 6 years by E. O. G. Kelly, of the Cereal and Forage Crop Insect Investigations, who in 1915 published his results as Bulletin 221 of the United States Department of Agriculture. In this are given descriptions of egg, larva, pupa, and feeding habits. Since this is the only account of the life history of any of the species, a short summary is here given:

The egg is small, oval, pale yellow, smooth and slightly glistening, about 0.036 inch in length and 0.015 inch in diameter. The female deposits her eggs in clusters of 10 to 50 in the crevices of earth or hollow straws near the corn plants. The eggs, depending on temperature, hatch in 6 to 10 days. They are laid early in April in northern Texas and to the middle of May in Kansas. The newly hatched pale yellow larva is about 1 mm. in length, nearly cylindrical, and with a somewhat flattened posterior end. The head is a little broader than the thorax and covered with downy hairs. Later the larva becomes creamy white. The mature larva is 6 to 8 mm. in length and 2 mm. in diameter. The larvae are found in the soil of cornfields in small earthen cells 4 to 6 inches deep with a tiny burrow leading toward the corn roots. Only in "dark waxy bottom land which becomes very gummy and sticky during wet weather and very hard in dry" were the larvae found. From about the middle of July to the middle of August the larvae in Kansas were pupating, and adults emerged from the first of August on in that area. They did considerable damage feeding on the unripe corn before going into hibernation in early fall. Early in spring the beetles attack young seedling corn crops and others.

Dr. W. H. Anderson, of the Bureau of Entomology and Plant Quarantine, has made a special study of the larva for me and has compared it with the larvae of related genera, and his description is here given:

### DESCRIPTION OF THE FULL-GROWN LARVA

"The brief characterization by Kelly<sup>9</sup> and the figures that accompany it are nearly sufficient for distinguishing larvae of the genus *Myochrous* from other eumolpine larvae. However, larvae of other

<sup>9</sup> U. S. Dept. Agr. Dept. Bull. 221, p. 4, 1915.



genera of the Eumolpinae, not known to Kelly, have been discovered and some additional remarks are necessary for a more adequate characterization.

"Abdominal segments II to VII each with a pair of elongate, ventral, ambulatory processes, each process obviously longer than its diameter at base and bearing stout setae on its inner surface, one of the setae at apex of process much longer than any of the others. Lateral anal lobes with the posterior surface sclerotized, flat and broad, each lobe divided by a transverse groove into two parts, the anterior (or ventral) part shorter than posterior part. Dorsal anal lobe enlarged, with the posterior surface flat, semicircular in outline. Dorsal and dorsolateral surfaces of mesothorax, metathorax, and abdominal segments I to VII with abundant, fine, elongate asperities. Posterior dorsal fold on abdominal segments I to VII with two pairs of slender setae. Dorsal surface of abdominal segments VIII and IX with approximately the same number of setae as on the corresponding areas of the anterior segments.

"Description based upon the following material: *Myochrous denticollis* (Say), Wellington, Kans., E. G. Kelly collector, Webster No. 6551; Monarch, Mo., June 1925, H. E. Roberts collector. None of the larvae in this material is in good condition. *Myochrous* sp., Las Cruces, N. Mex., September 20, 1943, at roots of sweetpotato.

"Larvae of *Myochrous* are most closely related to those of *Glyptoscelis* in so far as is known at present. The more readily discernible characters for separating larvae of the two genera are found at the posterior end of the body. Larvae of *Glyptoscelis* have the anterior (or ventral) part of each lateral anal lobe approximately twice as long as the posterior part and the dorsal surface of abdominal segments VIII and IX with many more setae than the corresponding areas of the anterior segments. Larvae of *Chrysochus*, while not as closely related to those of *Myochrous* as are those of *Glyptoscelis*, resemble larvae of *Myochrous* particularly in the presence of elongate ambulatory processes. Larvae of *Chrysochus* have many setae on the dorsal surface of the abdominal segments and the dorsal anal lobe is not flattened posteriorly." (W. H. ANDERSON.)

In general, the natural habitat of most of the species seems to be along marshy shores where they undoubtedly live in reeds and grasses. Even as adults they spend much time below the surface. Museum specimens are often caked with dried mud that clings to the scales and is difficult to remove without scraping off the scales. The beetles are active and strong fliers, however, as they have been collected on airplane flights. P. A. Glick,<sup>10</sup> in his experiments in collecting insects

<sup>10</sup> Distribution of insects, spiders, and mites in the air. U. S. Dept. Agr. Techn. Bull. 673, p. 69, 1939.



6. From 3.5 to 5 mm. in length; aedeagus with a not very acute tip  
(San Joaquin Valley, Calif.)----- *whitei*, new species  
From 4.5 to 5.5 mm. in length; aedeagus with a fine acute tip  
(southern California, Arizona, Colorado, Idaho)----- *longulus* LeConte
7. Body reddish brown or coppery, covered by yellowish or pale brown-  
ish scales, sometimes mixed with darker brown----- 8  
Deep piceous, often with bronzy luster, covered by grayish scales  
mixed with darker brown ones----- 11
8. Large, 6 to 8 mm. in length, unusually finely punctate, often having  
a median depression on anterior edge of prothorax (Browns-  
ville, Tex., and along lower Mississippi; Mexico)----- *magnus* Schaeffer  
Smaller, 4 to 6 mm. in length----- 9
9. Prothorax almost as long as wide, uneven with depressions, scales  
very dense and curved, tip of aedeagus prolonged into a slender  
point (Iowa, South Dakota, Kansas, Missouri)----- *movallus* Johnson  
Prothorax distinctly wider than long, without depressions.----- 10
10. Deep reddish brown, prothorax very rugose, with deep, coarse  
punctures and with no depressions except along basal margin  
(Virginia to Florida and west to Louisiana)----- *floridanus* Schaeffer  
Not quite so large and with less rugose prothorax, punctures not so  
coarse and distinct; aedeagus with a sharper tip (Columbia,  
Tex.)----- *floridanus texanus*, new subspecies
11. Prothorax large, approximately as wide as elytra, pinched in con-  
spicuously behind eyes and depressed along basal margin; beetle  
relatively short and broad (Virginia southward and along Gulf  
to Louisiana)----- *ranella*, new species  
Prothorax not so heavy and not conspicuously pinched in behind  
eyes; beetle more slenderly oblong----- 12
12. Scales on elytra rather fine and not so dense as to hide punctation  
below; prothorax without any pronounced median convexity  
(Mississippi Valley from Iowa to northern Texas, and from Mary-  
land to Georgia and along Gulf coast)----- *denticollis* (Say)  
Scales on elytra dense; prothorax with a median convexity----- 13
13. Elytral scales curved, not appressed; prothorax coarsely punctate  
(Arizona)----- *austrinus*, new species  
Elytral scales appressed, prothorax very finely punctate (southern  
Texas, New Mexico, Mexico)----- *cyphus*, new species

## MEXICO AND CENTRAL AMERICA

1. Deep reddish brown or coppery brown----- 2  
Piceous or black, usually with a bronzy luster----- 4
2. Thorax very densely and finely punctate, covered with dense yellow-  
ish scales (southern Texas and area below Brownsville in Mexico,  
and along lower Mississippi)----- *magnus* Schaeffer  
Thorax not very densely or very finely punctate----- 3
3. Large, 7 to 8 mm., covered with short white scales (Mexico)----- *sallei* Baly  
Smaller, 5 to 7 mm., covered by yellowish or pale brownish scales  
(Mexico, Guatemala, Honduras, Nicaragua, Panama)----- *tibialis* Jacoby
4. Small, 4.5 to 5 mm., aedeagus pale with a fine dark line down middle  
of tip (Panama)----- *elachus*, new species  
Larger, 5 to 6 mm----- 5
5. Aedeagus with a hollowed-out scooplike tip (Panama, Colombia).  
*platylonchus*, new species  
Aedeagus not scoop-shaped at tip----- 6

6. Thorax nearly as long as wide, rather flat, not densely punctate or very densely covered by scales, especially over head (Mexico).  
melancholicus Jacoby  
 Thorax definitely wider than long, densely punctate and densely covered by scales..... 7
7. Punctuation of thorax not coarse but dense and confluent, a convexity in middle of thorax..... 8  
 Punctuation of thorax coarser and distinct, not very often confluent, no pronounced convexity in middle of thorax..... 9
8. Punctuation of thorax exceedingly fine and in lines, the punctures not at all distinct; aedeagus short (southern Texas and New Mexico and region south of that in Mexico)..... cyphus, new species  
 Punctuation of thorax coarser, but still confluent and of indistinctly formed punctures; aedeagus longer (southern Arizona, Sinaloa, Mexico)..... austrinus, new species
9. Aedeagus tapering at tip; thorax with elongate punctures, tending to be in lines, sometimes confluent (Mexico)..... carinatus Jacoby  
 Aedeagus broadly rounded with a short, broad point..... 10
10. Thorax covered evenly by dense, deep, round punctures (Honduras, Guatemala, Nicaragua)..... femoralis Jacoby  
 Thorax with less regular punctuation, the punctures becoming coarser in basal portion; aedeagus smaller (Panama)-- coenus, new species

## SOUTH AMERICA

1. Middle tibiae and in male posterior tibiae with a spur before apex..... 2  
 Middle tibiae and posterior tibiae without spur before apex..... 3
2. Black, elongate, elytra usually more than twice as long as prothorax (Bolivia)..... calcariferus, new species  
 Deep reddish brown to piceous, elytra usually not more than twice as long as prothorax or even less (Venezuela)..... spinipes, new species
3. Clothed with long hairlike scales; only a faint trace of toothing on anterior tibiae (Peru, Chile)..... immundus Erichson  
 Not clothed with long hairlike scales; usually with a tooth on anterior tibiae..... 4
4. Apex of elytra with a band of pale scales..... 5  
 Apex of elytra without a band of pale scales..... 7
5. Anterior margin of thorax with a pair of gibbositities separated by a deep groove; anterior pair of tibiae not toothed (Brazil).  
curculionoides Lefèvre  
 Anterior margin of thorax thickened but not gibbose; anterior pair of tibiae toothed..... 6
6. Large, 7.5 mm.; elytra very wrinkled with irregularly shaped, often stellate punctures (Cayenne)..... leucurus, new species  
 Smaller, 6 to 7 mm.; elytra not very wrinkled, with small round punctures (Cayenne)..... crassimarginatus, new species
7. Each elytron faintly trivittate; aedeagus broad, almost truncate at apex with a small tip in middle (Trinidad, Brazil).  
rhabdotus, new species  
 Elytra not trivittate; aedeagus not truncate..... 8
8. Large, 8 to 9.5 mm.; thorax with flattened sides usually undulate, sometimes toothed (Venezuela, Colombia, Bolivia)..... explanatus Baly  
 Smaller; sides of thorax not flattened..... 9



9. Thorax with a thickened anterior margin, the scales on elytra forming either short vittae or pale spots or band from the humerus down toward the suture----- 10  
 Thorax usually not with a thickened anterior margin; elytra with no definite pale spotting or banding----- 12
10. Thorax as long as wide, with a white median stripe, and elytra with a long incurving band from humerus toward suture and a band before the apex not reaching the suture; aedeagus with a broadly pointed tip (Colombia)----- *darlingtoni*, new species  
 Thorax wider than long, almost as wide as elytra----- 11
11. Elytra reddish brown with the scales forming a spot below basal callosity in the center, sometimes connected with the pale spot on humerus, another in line with this before the apex and sometimes another on the side; aedeagus broad with very little trace of an acute tip at apex (Bolivia)----- *bolivianus*, new species  
 Elytra black with the white scales forming vittate or semivittate markings (Chaco Province, Argentina)----- *chacoensis*, new species
12. Aedeagus with a hollowed-out scooplike tip----- 13  
 Aedeagus not with a scooplike tip----- 14
13. Scales not so dense as to conceal punctation (Panama, Colombia).  
*platylonchus*, new species  
 Scales denser, concealing punctation; tip of aedeagus not quite so broad (Ecuador, Peru)----- *geminus*, new species
14. Aedeagus with a long drawn-out tip----- 15  
 Aedeagus not with an unusually long drawn-out tip----- 19
15. Deep reddish brown, thorax approximately as long as wide with small inconspicuous lateral teeth----- 16  
 Piceous, thorax not as long as wide, with the usual well-developed teeth----- 17
16. Large, 6.5 to 7 mm. (Salta, Jujuy, Argentina)----- *monrosi*, new species  
 Smaller, 5 mm. ("Pampas," Argentina)----- *stenomorphus*, new species
17. Large, 6 to 7 mm., tip of aedeagus very long drawn out (Brazil, Uruguay, Argentina, Chile)----- *armatus* Baly  
 Smaller, 5.5 to 6.5 mm., tip of aedeagus not so long drawn out----- 18
18. Thorax approximately as wide as elytra (Trinidad)----- *bryanti*, new species  
 Thorax not so wide as elytra (Paraguay)----- *sapucayensis*, new species
19. Length 4 to 5 mm----- 20  
 Length 5 to 6 mm----- 22
20. Aedeagus pale with a dark furrow down tip (Panama, Colombia).  
*elachius*, new species  
 Aedeagus without a dark furrow down tip----- 21
21. Elytra sparsely striate-punctate (Bolivia, Paraguay)----- *nanus*, new species  
 Elytra with usual rather dense striate punctation (British, French, and Dutch Guiana, Venezuela, Brazil)----- *paulus*, new species
22. Upper surface covered by unusually wide scales (Colombia).  
*latisetiger*, new species  
 Upper surface not covered by unusually wide scales----- 23
23. Reddish brown; aedeagus tipped with a fine point at apex----- 24  
 Piceous; aedeagus tipped with a broad point at apex----- 26
24. Covered by grayish or pale brownish scales, the reddish-brown color not showing through; thorax much wider than long, finely punctate (Colombia, Peru, Venezuela, Brazil, Bolivia)----- *longipes*, new species  
 Covered by short yellowish scales, the reddish-brown color showing through----- 25

25. Prothorax with anterior margin projecting over head, surface densely but not coarsely punctate (Bolivia) ----- *mamorensis*, new species  
 Prothorax with anterior margin not projecting over head, coarsely but not very densely punctate (Amazon Valley, Brazil).

- *brunneus*, new species  
 26. Thorax densely and coarsely punctate (Paraguay) ----- *normalis*, new species  
 Thorax not very densely punctate (Barbados, Grenada, Trinidad, British and Dutch Guiana) ----- *barbadensis* Blake

*M. figueroae* Brèthes is not included in this key, since no male specimens have been available. The beetle resembles *M. armatus* Baly but has not so large a thorax.

#### MYOCHROUS DENTICOLLIS (Say)

##### PLATE 1, FIGURE 1

*Colaspis denticollis* SAY, Journ. Acad. Nat. Sci. Philadelphia, vol. 3, p. 448, 1824.  
*Myochrous denticollis* LeConte, Writings of Thomas Say, vol. 2, p. 215, 1859.

From 4 to 5.5 mm. in length, broadly oblong, black with a bronzy luster, moderately lightly covered by narrow brownish and white scales. Prothorax broadly rounded and without marked convexities, with a little depression over the scutellum and a 3-toothed margin; surface with fine lines of dense, confluent, and shallow punctures; elytra with coarse, dense, and, in basal half, contingent punctures in rows visible through the scales.

Head down to antennal sockets covered by scales completely hiding the punctation, a narrow ridge extending down on each side of occiput, the punctation beneath the scales in fine lines radiating from a shallow median vertical depression; lower front between the antennal sockets shining under the light, white pubescence, the scales here becoming less dense and more hairlike, each one coming from a coarse puncture; punctures here not quite so dense and producing a wrinkled effect across lower front. Antennae not extending much below humeri, a little shorter in the female, reddish brown, joint 1 broadly cylindrical, joint 2 globular, joints 3 to 6 slender, shining, 7 to 11 thicker and densely pubescent. Prothorax considerably broader than long, broadly rounded but not very convex, with a little depression at base over the scutellum, sides with three teeth and a tooth at apical and basal angles; punctation visible through the scales, dense and confluent, in fine, shallow, longitudinal lines. Elytra only a little wider than prothorax, moderately convex, humeri prominent with short intrahumeral depression, the rows of punctures close in the basal half, but the punctures becoming finer and less dense toward the apex; scales not so dense as to hide the punctation, narrow and somewhat curved, not lying flat, the scales from the middle of the punctures narrower and smaller and lying more appressed to the surface. Body beneath shiny, not so densely scaly, coarsely punctate

with a more hairlike scale from each puncture, the scales on the prosternum like those on the upper surface. A small depression at the tip of the abdomen in both sexes, roundish in the female, more triangular in the male. Hind femora bluntly toothed, anterior tibiae toothed on the inner side. Length 4.2 to 5.5 mm.; width 2 to 2.5 mm.

*Type*.—Unknown.

*Type locality*.—"Inhabits Missouri."

*Other localities*.—MARYLAND: Chesapeake Beach, Plumpoint (in thicket of reeds near the beach); VIRGINIA: Alexandria, Fredericksburg, Fort Monroe, Nelson County, Nutbush; DISTRICT OF COLUMBIA: Rock Creek Park; WEST VIRGINIA: Ripley, White Sulphur Springs; NORTH CAROLINA: Clemson College; GEORGIA: Miner; OHIO: Marietta; INDIANA: Paxton (on corn), Vincennes; KENTUCKY: Glasgow, Henderson; TENNESSEE: Clarksville, Henderson; ALABAMA: Montgomery; MISSISSIPPI: Clarksville, Grenada (on turnip), Hancock County, Meridian; Natchez (on *Ambrosia psilostachya*), Rockport, Vicksburg; LOUISIANA: Alexandria (on cotton boll), Ama (feeding on okra), Bunkie (on cotton), Caddo Parish, East Port, Gueyden, Houma (in sugarcane sheath), Lafayette (in stem of sugarcane), Many, New Orleans (on globe artichoke), Opal, Palm, Madison Parish, St. James, Shreveport (on cotton square), Southport (in sugarcane fields); TALLULAH (on cotton), Vidalia; TEXAS: Clarksville (on *Helenium* roots), Dallas, Greenville, Mesquite, Plano, Raymondville, Utopia, Wolfe City (on *Helenium tenuifolium*); ARKANSAS: Beebe, Conway, Oil Trough, Scott County, Paris, Pine Bluff (on cotton), Texarkana; OKLAHOMA: Medford, Oklahoma City, El Reno, Tulsa County; KANSAS: Douglas County, Leavenworth, Onaga, Riley County, Washington County (in cornfield, many specimens), Wellington; MISSOURI: Bellflower, Columbia, Charleston, Oran, St. Louis; IOWA: Appanoose County, Davis County, Decatur County, Jefferson County, Lee County, Page County, all from "B. Blue stem."

*Remarks*.—Although there are two species occurring in the region from which Say described *Colaspis denticollis*, it seems likely that the species that is abundant throughout this area should be the one he collected rather than the species that is rare in collections and that was described much later in 1931 from North Dakota (*Myochrous movallus* Johnson). Horn, in describing Say's species, writes that the scales are not closely placed and permit the bronze color to be readily visible. This description does not apply to *M. movallus*, which is more densely covered by broader scales. In the species that is abundant, which is probably Say's species, the scales are narrow and not very dense. In fact, *denticollis* is one of the least densely pubescent of any of the North American species of *Myochrous*. Furthermore, the thorax is broad and not very convex, in contrast with other

species, and the rows of striate punctures on the elytra are more crowded.

*M. denticollis* appears to be found most abundantly in the central Mississippi Valley. It occurs as far north as Iowa and Illinois and is found in collections from Kansas, Missouri, Oklahoma, Arkansas, and south into northern Texas, Louisiana, and Mississippi. Less common are specimens from Kentucky and Tennessee, and there are comparatively few specimens from West Virginia, Virginia, Maryland, North Carolina, and Georgia. I have found it on the edge of a thicket of reeds, at Plumpoint, Md., where the beetles were not very abundant and seemed to spend much of their time out of sight in the sand around the roots of the reeds.

Because the beetles are injurious to young corn as well as to sugarcane and other garden crops, this species has become well known in economic literature as the southern corn leaf-beetle. As early as 1887 in a report of the United States Commission on Agriculture, Riley<sup>11</sup> reported it as a pest. Webster<sup>12</sup> in 1900 to 1901 gave several accounts of its destructiveness in Ohio to seedling corn. Tucker<sup>13</sup> called attention to a serious outbreak in Butler County, Kans., which necessitated the replanting of "hundreds of acres of corn." Farther south in Louisiana and Mississippi it has been found injuring cotton and also sugarcane. An unusually full account of the immature stages and life history has been given by E. O. G. Kelly<sup>14</sup> in connection with its destructiveness to corn.

A series of specimens sent from Mexico as injuring corn at Perjamo, Guanajuato, August 30, 1909 (sent by Julio Reguelma), cannot be distinguished from the North American specimens of this species.

MYOCHROUS CYPHUS, new species

PLATE 1, FIGURE 3

From 4 to 6 mm. in length, oblong, piceous, shining with a bronzy luster; prothorax with a 3-toothed margin, a depression along the base, and a median convexity, the rows of elytral punctures not so closely placed as in *denticollis* and the scales coarser, denser, and concealing more the punctation below.

Head covered by dense scales down to antennal sockets, a more or less distinct median line, the punctation dense and fine and radiating from the middle in lines, a ridge on each side of occiput. Lower front rather less densely and not very coarsely punctate, with a fine scale from each puncture. Antennae yellowish or reddish, and of the usual proportions. Prothorax not so long as wide, with a prominently 3-

<sup>11</sup> Rept. U. S. Comm. Agr., 1887, p. 150.

<sup>12</sup> U. S. Dept. Agr., Div. Ent. Bull. 26, new ser., 1900; Journ. New York Ent. Soc., vol. 9, pp. 128-132, 1901.

<sup>13</sup> U. S. Dept. Agr. Yearbook, 1905, p. 634.

<sup>14</sup> U. S. Dept. Agr. Dept. Bull. 221, pp. 1-11, 1915.



toothed margin and a tooth at apical and basal corners and a moderate depression along basal margin and well-marked median convexity; surface finely, densely, and confluent punctate in longitudinal lines. Elytra a little wider than prothorax with small humeral prominences and a short intrahumeral sulcus; the rows of punctures not quite so crowded together as in *denticollis* and more densely covered by scales, the scales being not so fine, in well-marked specimens the brown-and-white scales tending to form short stripes. Body beneath shining, dark brown with a bronzy luster, tip of abdomen usually reddish, the scales on breast and abdomen not so thick and finer; first abdominal segment coarsely and moderately densely punctate. Hind femora with a blunt tooth, anterior tibiae with the usual inner tooth. Length 4.1 to 6 mm.; width 1.9 to 2.8 mm.

*Type and paratypes*.—Type male and 38 paratypes, U.S.N.M. No. 59030, collected by R. A. Vickery on corn; 2 paratypes in Museum of Comparative Zoology.

*Type locality*.—Brownsville, Tex.

*Other localities*.—TEXAS: Abilene, Taylor County, Anahuac, Alligator Head, Calhoun County, Austin (on Irish potatoes), Los Borregos and Fort Brown in Brownsville (on cotton), Buckeye, Matagorda County (on flooded rice), Canutillo (on corn), Carmine, Catarina, Catulla, Columbus, Corpus Christi, Del Rio, Edinburg, El Paso, Fort Davis, Gregory, Hearne (on cotton), Hidalgo (in sugarcane stalk), Jim Wells County, Kerrville, Kingsville (on wheat), Lufkin (on cotton), New Braunfels, Raymondville, Sugar Land, Trinity (on cotton), Utopia (on corn), Victoria (on corn and cotton), Wellborn, Weslaco, Yaleta; NEW MEXICO: Las Cruces, Mesilla Park, Socorro.

*Remarks*.—This species is very easily confused with *denticollis*. It differs from it in having not a flattish prothorax but one in which there is a distinct median hump. In general it is a more slender species and has a denser vestiture of thicker scales than *denticollis*, and the elytral punctures are not so crowded. The aedeagus, while resembling that of *denticollis*, is larger and longer. It is undoubtedly a Mexican species that does not extend farther than the southern part of Texas. It has been frequently intercepted in shipments of bananas, pineapples, sugarcane stalks, avocados, and tomatoes from Mexico. Usually no definite localities for its occurrence in Mexico can be obtained, but from two, Matamoros, taken on cotton, and Ciudad Mante, Tamaulipas, on tomato, it would appear to be found in the region just south of Brownsville. There is also one specimen in the Bowditch collection, Museum of Comparative Zoology, which Jacoby had put under *M. melancholicus* and which comes from Paso del Norte, Chihuahua, Mexico, a region south of New Mexico.

## MYOCHROUS AUSTRINUS, new species

## PLATE 1, FIGURE 5

About 5.5 mm. in length, elongate oblong, shining piceous with a bronzy luster, prothorax 3-toothed and rather convex, as in *M. cyphus*, with dense, often confluent, moderately coarse punctation, the brown and white scales not so dense as to hide completely the sculpture, and not closely appressed but curving.

Head densely covered with scales to antennal sockets, the punctures beneath coarse and dense; in some specimens traces of a median line down front, the usual occipital ridge on either side. Antennae yellowish or reddish, of the usual proportions. Prothorax wider than long, conspicuously 3-toothed on lateral margin with a tooth at apical and basal angles; disk with a median convexity and a basal depression along the margin, most pronounced over the scutellum; punctation moderately coarse and confluent, in longitudinal lines, not entirely concealed by the yellowish-gray scales. Elytra with small humeral prominences and a basal callosity with a depression below in which the punctures are transversely ridged; punctures coarse and closely placed, becoming much finer and less dense toward apex; scales not entirely concealing punctation, not very coarse or closely appressed but curved. Body beneath shining with a bronzy luster beneath the rather fine white scales, tip of abdomen reddish, first abdominal segment moderately coarsely and densely punctate. Hind femora bluntly toothed, anterior tibiae with the usual inner tooth. Length 5 to 5.8 mm.; width 2.2 to 2.3 mm.

*Type*.—A female, U.S.N.M. No. 59027, collected at 2,300–2,500 feet, July 13 to 15, by H. F. Wickham.

*Type locality*.—Tucson, Ariz.

*Other localities*.—ARIZONA: San Bernardino Ranch, Cochise County, 3,700 feet (F. H. Snow; two specimens in Snow collection at Kansas University, one specimen in the Museum of Comparative Zoology at Cambridge).

*Remarks*.—At first glance this species might be confused with *M. cyphus* because of the slight convexity on the thorax. The curved and not closely appressed scales and the more coarsely punctate thorax distinguish it from that species. This may very well be a Mexican species slowly extending into Arizona. A series of specimens from Los Mochis, Sinaloa, Mexico, collected by C. T. Dodds on June 27, 1922, in the collection of the California Academy of Sciences, appears to be the same as the Arizona specimens. There is, unfortunately, no male among the four Arizona specimens for comparison of the aedeagi. A drawing of the aedeagus of a male from Los Mochis, Mexico, is given, showing it to be similar to both *M. cyphus* and *M. denticollis* in the structure of the soft membranes, but larger than either. There

is also considerable resemblance to the southern Mexican species, *M. carinatus* Jacoby, but the thorax is more convex and has denser, more confluent punctures than does that species.

MYOCHROUS MELANCHOLICUS Jacoby

PLATE 1, FIGURE 4

*Myochrous melancholicus* JACOBY, Biologia Centrali-Americana, Coleoptera, vol. 6, pt. 1, p. 174, 1882.

*Myochrous carinatus* JACOBY, in Bryant, Ann. Mag. Nat. Hist., ser. 9, vol. 12, p. 137, in part, 1923.

About 5 mm. in length, elongate oblong, rather flat, shining black beneath the pale closely appressed scales, scales on head unusually fine, showing punctation beneath; punctation on thorax not confluent or ridged, the punctures separate and not very coarse; thorax only a little wider than long.

Head compared with other species rather bald, the scales unusually fine over the occiput, a bit coarser behind the eyes; the sculpture plainly visible, consisting of rugose, irregular punctures and the usual ridges on either side of the occiput. Antennae of the usual proportions. Prothorax a very little wider than long with a 3-toothed margin, not very convex, a faint depression on either side below the middle and a well-marked depression along the base, especially over the scutellum; punctures not so dense or coarse as in *carinatus* and not in lines, denser and larger toward the base; scales not very thick. Elytra only slightly convex, without basal callosities, a faint transverse depression in basal half in which there is a tendency to transverse ridging; punctures well spaced, not very coarse except about scutellum; scales easily rubbed off but apparently not dense, rather coarse and pale. Body beneath having the first abdominal segment with small scattered punctures. Hind femora bluntly toothed, anterior tibiae with the usual inner tooth. Length 5.2 mm.; width 2.3 mm.

*Cotype*.—In Bowditch collection, Museum of Comparative Zoology; ? cotypes in British Museum of Natural History.

*Type locality*.—In an endeavor to exclude other species that may be included in Jacoby's material, I hereby designate Córdoba, Mexico, Sallé collection, as the type locality.

*Remarks*.—There was some confusion in Jacoby's understanding of *Myochrous melancholicus*. In his original description he gives the following localities: Córdoba, Texpam (Sallé), Playa Vicente (Höge), Panama (coll. Jacoby). In the Supplement (1891) he adds Villa Lerdo in Durango, Cholula in Puebla, and Frontera in Tabasco (Höge). In the Bowditch collection at Cambridge are further specimens from Jacoby's collection containing two additional localities—Paso del Norte, Chihuahua, and Acapulco, Mexico. Of Jacoby's specimens mentioned in the Biologia I have examined specimens from



Córdoba, Panama, and Frontera in Tabasco. One from the last-named locality was sent to me from the British Museum and identified as *carinatus* by Bryant, who synonymized *melancholicus* with *carinatus*. The result of dissection shows that this specimen is *M. tibialis* Jacoby. The Córdoba and Panama specimens each represent different species. And the specimens from Paso del Norte and Acaapulco are two more distinct species, making in all five species of those that I have examined that Jacoby placed under the name *melancholicus*. In view of this confusion I have selected the type locality as Córdoba, Mexico, in an endeavor to fix the species. This specimen from Córdoba, a male, is smaller and flatter than *M. carinatus* with less dense thoracic punctation having no tendency to be in confluent lines. The scales on the head are finer. The tip of the aedeagus is not so tapering, and the whole aedeagus is shorter.

MYOCHROUS CARINATUS Jacoby

PLATE 1, FIGURE 7

*Myochrous carinatus* JACOBY, Biologia Centrali-Americana, Coleoptera, vol. 6, pt. 1, Suppl., p. 230, 1891.

From 5 to 6 mm. in length, elongate oblong, shining with a bronzy luster through the yellowish-gray scales; scales somewhat curved and not hiding sculpture below entirely; prothorax a little wider than long, with moderately coarse, dense, somewhat elongate punctures tending to be in lines.

Head densely covered with scales down to antennal sockets, with the usual occipital ridge on either side of occiput (no more developed than in other species, however); punctation beneath the scales somewhat visible and tending to be in lines radiating from the vertex. Antennae reddish brown, of the usual proportions. Prothorax wider than long (contrary to Jacoby's statement), with three lateral teeth and the usual tooth at apex and base; punctation dense, moderately coarse, tending to be in lines, but not ridged; scales not flatly appressed but a little curved. Elytra with a little depression below the basal callosity, and transversely ridged especially in this depression; scales not so dense as to hide punctation, and short, curved, pale yellowish gray mixed with pale brown; elytral striae close, punctures touching each other in basal portion, with transverse ridgings. Body beneath with scattered punctures on the first abdominal segment, pubescence fine and pale. Hind femora with a blunt tooth, anterior tibiae with the usual tooth. Length 4.9 to 6.2 mm.; width 2.3 to 2.7 mm.

*Cotypes*.—In Bowditch collection, Museum of Comparative Zoology (3 specimens) and ? in British Museum of Natural History.

*Type locality*.—In an endeavor to exclude other species that may be included in Jacoby's material, I hereby designate the type locality as San Juan Bautista in Tabasco, Mexico, Höge collector.

*Remarks.*—Contrary to Jacoby's description the prothorax in the San Juan Bautista specimens is wider than long, and furthermore the ridges on the occiput are not any more developed than in the majority of the species. The prothorax is rather more finely punctate than in most Central American species of *Myochrous*, with a tendency for the punctures to be elongate and to occur in longitudinal lines. The aedeagus is more tapering than in *M. femoralis* or *M. melancholicus* and more like the North American species *M. denticollis*. A number of specimens of what seem to be this species have been intercepted in shipments of bananas from Mexico at New Orleans. Apparently it is abundant in certain banana-growing districts.

## MYOCHROUS SQUAMOSUS LeConte

## PLATE 2, FIGURE 1

*Myochrous squamosus* LECONTE, Smithsonian Contr. Knowl., vol. 11, p. 24, 1859.

About 5 mm. in length, oblong, black, shining with a bronzy, sometimes bluish luster, covered by wide, flat, brown-and-white scales, in many specimens forming a white lateral elytral vitta, sometimes scales on elytra entirely pale, sometimes brown with several more or less interrupted white vittae; prothorax not definitely toothed but with an anterior angularity; elytral punctation not round but angular or star-shaped.

Head rounded over occiput and covered with scales down to antennal sockets, no trace of median depression or of the usual occipital ridges, punctation fine, dense and in lines; lower front shining under sparser, finer scales, with scattered punctures. Antennae reaching below humeri, reddish brown, of the usual proportions, outer joints thicker. Prothorax a little wider than long, widest anteriorly, and without lateral toothing but with an anterior angularity, a small tooth at apical and basal angles; punctation tending to be in confluent lines, but not so dense as in the other species of this group and without ridgings. Elytra with small humeri, a short intrahumeral depression, the rows of punctures not closely placed and punctures somewhat star-shaped, becoming much finer and less dense in the apical half; scales very broad and flat, covering punctation, rather easily rubbed off, forming various color patterns, sometimes entirely pale, usually brownish with a white lateral vitta and spot at apex, sometimes several broken vittae or spots. Body beneath shining with a metallic luster beneath the white scales, the scales on abdomen finer; first segment finely and rather densely punctate; abdomen of female without depressions, a faint triangular depression at tip of male abdomen; legs reddish brown. Hind femora without tooth, anterior tibiae with a small inconspicuous tooth on inner side. Length 4.3 to 5.5 mm.; width 2 to 2.5 mm.

*Type*.—A female in the LeConte collection, Museum of Comparative Zoology.

*Type locality*.—"Platte River [Kansas] under dried buffalo excrement."

*Other localities*.—ALBERTA: Chappice Lake, Medicine Hat; SASKATCHEWAN: Roche Percee; MONTANA: Big Horn County; WYOMING: NORTH DAKOTA: Medora; SOUTH DAKOTA: Avance, Belle Fourche, Browns Valley, Canning, Canton, Cedar Canyon, Chamberlain, Cheyenne Agency, Fort Thompson, Fox Ridge, Gettysburg, Highmore, Houghton, Kimball, Lantry, Martin, Newell, Oelrichs, Philip, Rapid City, Spearfish, White Lake; NEBRASKA: Columbus, Crete, Lincoln, McCook, West Point; IOWA: Council Bluffs, Sioux City; COLORADO: Colorado Springs, Fort Collins, Greeley, Las Animas, Pueblo; UTAH: Salt Lake; NEW MEXICO: Coolidge; KANSAS: Clark County, Gove County, Meade County; TEXAS: Dallas.

*Remarks*.—Of 231 specimens collected in June and July 1947 in South Dakota by H. C. Severin, only 9 were males. No male specimen had previously been found in all the collections examined. In his treatment of the Eumolpini in 1892, Horn mentioned that he had seen only females. The species has the broadest scales of any species of the genus in the United States. There is considerable variation in the color pattern formed by the scales, some beetles having the elytra entirely white, but the elytra are more commonly brown with a lateral white stripe and remnants of a median one, frequently abbreviated to spots or an apical vitta. The scales appear bifid at times as in the European genus *Pachnephorus*, and this character coupled with the untoothed thorax make this species somewhat intermediate between the two genera. The posterior tibiae are not emarginate, however, and the distal joints of the antennae not so enlarged as usual in *Pachnephorus*, and the first abdominal segment not quite so long. It is one of the most atypical of the species of *Myochrous* and forms, with the three succeeding species, a little group of its own.

MYOCHROUS INTERMEDIUS, new species

PLATE 2, FIGURE 3

From 4 to 5 mm. in length, elongate oblong, black, somewhat shiny, covered with broad brown and white scales that are easily brushed off, in well-marked specimens these scales forming an interrupted pale lateral elytral vitta and a spot near the apex; prothorax without definite lateral toothing but angulate near the apex; elytral punctation not round, more triangular or star-shaped; anterior tibiae with very tiny inner tooth.

Head covered by scales down to antennal sockets, sometimes a faint median line, but no distinct occipital ridges, punctation beneath scales dense, fine and in lines; lower front shining, with a few fine scales and



rather coarse punctures. Antennae extending below humeri, distal joints thickened, deep reddish brown becoming darker. Prothorax almost as long as wide, rather convex in middle, depressed over the head, lateral margin without toothing but angulate near apex and often with a little angularity or undulation near base, a small apical and basal tooth; confluent punctate in lines, these forming a slight ridge on either side near the base. Elytra with small humeri and a short intrahumeral depression, the rows of punctures not very closely placed and becoming less dense and finer toward the apex, punctures not round but angular and between them finer, shallower punctures, the points of attachment of scales, the brown and white scales easily rubbed off, forming in well-marked specimens a lateral white interrupted vitta and spot near the apex. Body beneath shining with a bronzy luster and covered with fine white scales, first abdominal segment densely and finely punctate; tip of abdomen in male with a small pit, only a faint depression in female, a small undeveloped tooth on inner side of anterior tibiae. Hind femora not distinctly toothed. Length 4 to 5.4 mm.; width 1.9 to 2.6 mm.

*Type*.—A male, U.S.N.M. No. 59024, collected by McCrory, May 20, 1928.

*Type locality*.—Mount Pleasant, Iowa.

*Other localities*.—ILLINOIS; MISSOURI: Columbia; KANSAS: Cherokee County, Coffey County (R. H. Beamer; on rosinweed); Onaga (F. F. Crevecoeur); Topeka (Popenoe); INDIAN TERRITORY: Vinita (H. F. Wickham); TEXAS: No specific locality (Belfrage); College Station (W. D. Pierce), Columbus, Cypress Mill, Edna (J. D. Mitchell), Victoria (J. D. Mitchell), Lee County (Fall collection).

*Remarks*.—This species is intermediate between *M. squamosus*, the species with very wide scales, and *M. severini*, the species with very short, small scales. The aedeagi of *intermedius* and *severini* are almost indistinguishable in their outward appearance. The beetles are easily distinguished by the difference in vestiture and the less marked angularity on the sides of the thorax of *intermedius*. From *squamosus* it is to be distinguished by its narrower scales, and the fact that the punctures on the prothorax are not distinctly separated but are fine and in dense lines of confluent punctures.

#### MYOCHROUS SEVERINI, new species

#### PLATE 2, FIGURE 2

From 4.5 to 5.5 mm. in length, elongate oblong, rather dull black, with a faint bluish luster, with sparse, short, fine, white scales, prothorax feebly 2-toothed or 2-angled along margin and finely and confluent punctate in lines; elytral punctuation not dense, and finer toward apex, striate punctures not round but somewhat triangular or

star-shaped, interspersed with finer punctures. Anterior tibiae with only a faint trace of tooth.

Head thinly covered with fine, closely, appressed white scales down to antennal sockets, a short vertical line in the middle of the front, punctation dense, moderately coarse, but surface not at all rugose, and little trace of the usual occipital ridging; lower front without scales, with a few coarse punctures. Antennae extending below humeri, brown with darker and thicker outer joints, of the usual proportions. Prothorax not quite as long as wide, convex, with a depression over the head and along the base at the sides; sides feebly 2-toothed with a little blunt tooth at apical and basal angles; disk with fine, confluent punctures in lines, sparsely covered with short, fine scales. Elytra with small humeri and a short intrahumeral sulcus, a faint basal callosity; the striate punctures not round but somewhat triangular, often star-shaped and interspersed with finer, shallower punctures, the larger punctures becoming finer and less dense toward apex; whitish scales short, fine, and not very dense. Body beneath shining, densely punctate, scales fine and hairlike, first abdominal segment finely and moderately densely punctate, a faint depression at tip of abdomen in the male, not so marked in the female. Hind femora not distinctly toothed, anterior tibiae with an inconspicuous tooth on inner side. Length 4.5 to 5.4 mm.; width 2 to 2.5 mm.

*Type*.—A male, U.S.N.M. No. 59025, collected June 22, 1935, by K. Cooper.

*Type locality*.—Sentinel Butte, N. Dak.

*Other localities*.—A female, collected at Lantry, S. Dak., June 28, 1947, by H. C. Severin.

*Remarks*.—Only two specimens, a male and female, are known. They are unique among North American species of *Myochrous* in being inconspicuously scaly, the scales very short and not dense. Otherwise the beetles resemble closely *M. intermedius*, which is covered with broad scales. The aedeagi of both are very similar in outward appearance.

#### MYOCHROUS PAUXILLUS Schaeffer

#### PLATE 2, FIGURE 5

*Myochrous pauxillus* SCHAEFFER, Journ. New York Ent. Soc., vol. 41, p. 473, 1933.

About 4.5 mm. in length, oblong, black, shining with a bronzy luster, densely covered by broad pale scales easily rubbed off, thorax widest anteriorly with a distinct angularity, scarcely a toothing, visible below the middle; elytral punctures round and coarse.

Head covered by dense, appressed, white scales down to antennal sockets, the usual occipital ridges absent, a faint median line and fine longitudinal lines of confluent punctures radiating from this; lower front polished and with coarse punctures and a few finer hairlike

scales. Antennae extending below the humeri, dark reddish brown, third joint longer than fourth, distal joints thicker. Prothorax definitely wider than long with the widest part anteriorly an angularity, scarcely a toothing, on each side below the middle, and a small tooth at apical and basal angles; disk convex in the middle and a little depressed over the head; punctures confluent with fine longitudinal ridges, a similar sort of elevation on sides near the base as in *M. intermedius*; scales easily rubbed off. Elytra with sharp humeral prominences and an intrahumeral sulcus; rows of striate punctures coarse and round and closely placed in basal half, becoming finer and less dense toward apex; scales broad and appressed and concealing the punctation. Body beneath shining bronzy with fine white scales; legs reddish brown; no definite toothing on hind femora, front tibiae with a small tooth on inner side, not so much developed as in most species; first abdominal segment finely and rather densely punctate; abdomen of male alone depressed at the tip. Length 4.2 to 4.7 mm.; width 1.8 to 2.2 mm.

*Type*.—A male, from the Schaeffer collection, in possession of H. S. Barber, Washington, D. C.

*Type locality*.—Esperanza Ranch, Brownsville, Tex.

*Other localities*.—Los Borregos, Brownsville, collected by H. S. Barber, June 5, 1904.

*Remarks*.—This is the fourth of the *squamosus* group, which includes also *M. intermedius* and *M. severini*. They differ from most species by not having a 3-toothed thorax and by having very poorly developed toothing on the anterior tibiae. In this species the thorax is very broadly dilated anteriorly and more angular below the middle, and it also differs from the rest of the group by having round and not star-shaped or angular elytral punctures. Beetles of this species have been collected only about Brownsville, Tex.

#### MYOCHROUS RANELLA, new species

#### PLATE 2, FIGURE 5

From 3 to 5 mm. in length, broadly oblong, convex, shining black, sometimes with a bronzy luster beneath the rather broad brown and white scales. Prothorax almost as broad as the elytra, with a 3-toothed margin, convex and pinched in behind the eyes and depressed along the basal margin. Thoracic punctation fine, dense, and in longitudinal, confluent lines; rows of elytral punctures not so crowded as in *denticollis*.

Head with widely separated eyes, covered by scales down to the antennal sockets, beneath the scales the punctures dense and in lines; no trace of a median vertical depression, a ridge on each side running down over the occiput above the eyes; lower front shining under the

light scattered scales, these scales thinner than the ones on occiput; the punctures not so coarse as in *denticollis* or *movallus*. Antennae extending a little below the humeri, the five distal joints heavier and darker brown. Prothorax nearly as broad as elytra and considerably wider than long, with a 3-toothed margin and tooth at basal and apical angles; depressed along basal margin especially over the scutellum, convex otherwise, a flat area over the head and conspicuously pinched in behind the eyes; punctation rather deep and confluent and in longitudinal lines; scales dense, closely appressed and concealing punctation. Elytra about twice as long as the prothorax, broad, convex, with sharp little humeri and no basal callosity, the rows of punctures not so closely placed as in *denticollis*; scales rather broad and closely appressed. Body beneath shining under less dense scaliness, abdomen with finer scales, first segment moderately densely but not very coarsely punctate; a round depression at tip of female abdomen and a more triangular one on male. Legs short and heavy, a trace of a blunt tooth on hind femora and a sharp tooth on inner side of anterior tibiae. Length 3.2 to 5.5 mm.; width 1.8 to 2.7 mm.

*Type and paratypes*.—Type male and two female paratypes, U.S.N.M. No. 59026.

*Type locality*.—Jacksonville, Fla., collection of Ashmead.

*Other localities*.—FLORIDA: Archer, Brooksville (P. J. Darlington), Dunedin (W. S. Blatchley), Homestead (R. H. Beamer); GEORGIA: Baconton; SOUTH CAROLINA: Florence (R. H. Beamer); NORTH CAROLINA: Southern Pines; VIRGINIA: Virginia Beach (A. P. Morse); ALABAMA: Delchamps, Mobile (H. Soltau); MISSISSIPPI: Hancock County (H. Soltau); LOUISIANA: Covington (H. Soltau).

*Remarks*.—This is one of the most distinct of North American species of *Myochrous*. The broad heavy thorax, which is a third as long as the beetle, with its peculiar pinched-in depression behind the eyes, is very striking. The legs are short, the scales are coarser than in *denticollis*, and the elytral punctures are less dense.

#### MYOCHROUS MOVALLUS Johnson

##### PLATE 3, FIGURE 3

*Myochrous movallus* P. H. JOHNSON, Can. Ent., vol. 63, p. 148, 1931.

From 4 to 5 mm. in length, elongate oblong, dark reddish brown, densely covered with brown and white scales, often giving the beetles a speckled appearance; thorax nearly as long as wide, inconspicuously 3-toothed, decidedly convex and with a depression along the base and suggestion of a median depressed line; elytra also rather convex.

Head densely covered with brown and white, closely appressed scales forming a brown, irregularly star-shaped pattern on front, a median depression down front and a somewhat indistinct ridge on either side of the occiput extending down to above the eyes; surface



under the scales densely and moderately coarsely punctate; lower front less densely covered with scales, the scales being placed transversely. Antennae reddish with the distal joints darker, of the usual proportions. Prothorax almost as long as broad, with margin rather inconspicuously 3-toothed and a tooth at apical and basal angles; convex with a distinct depression along the basal margin most pronounced over the scutellum, and in some specimens a marked median line, this line varying in distinctness in individuals, also a tendency for a depression on either side behind the middle, in short the disk rather uneven; very densely covered with brown and white scales, the scales being curved and hiding the punctation beneath; punctures dense, confluent and not very coarse or deep, becoming coarser near the basal angle. Elytra wider than prothorax, smoothly convex with small humeri and a short intrahumeral sulcus; the rows of punctures densely placed, the punctures becoming finer and not so dense toward the apex; scales so dense as to hide the punctation almost entirely, and rather thick and curved. Body beneath deep reddish brown with the tip of the abdomen paler, shining, the abdomen not so densely covered by white appressed scales, the first segment as in *denticollis*, moderately densely punctate; the female with a faint round depression in the middle of the last segment, the male with a still fainter triangular depression located near the tip. Legs reddish, covered with scales, the anterior tibiae toothed on the inside, a very faint suggestion of toothing on the hind femora. Length 3.8 to 5.5 mm.; width 1.8 to 2.5 mm.

*Cotypes*.—Five cotypes, one in the Schaeffer collection in the National Museum, two in the collection of the South Dakota State College, Brookings, S. Dak., location of the rest unknown.

*Type locality*.—Elk Point, S. Dak.

*Other localities*.—KANSAS: Atchison County in collection of University of Kansas, collected by R. H. Beamer; MISSOURI: Atherton; IOWA: East Point.

*Remarks*.—This is an easily recognized species because of its narrow convex prothorax, which is almost as long as wide. It is also one of the deep reddish brown species. The densely crowded scales on the entire upper surface are unlike the sparse vestiture of *M. denticollis*. The scales are not flatly appressed but curved and present a rounded appearance when viewed with a microscope, and they are coarser than the scales of *denticollis*.

#### MYOCHROUS FLORIDANUS Schaeffer

#### PLATE 2, FIGURE 6

*Myochrous floridanus* SCHAEFFER, JOURN. New York Ent. Soc., vol. 41, p. 472, 1933.

From 5 to 6 mm. in length, elongate oblong, deep reddish brown to piceous, usually the prothorax darker, somewhat shining beneath the dense, appressed, yellowish and brown scales; prothorax not quite



so long as broad, with a 3-toothed margin, smoothly convex with a depression along the basal margin, deeply, coarsely, rugosely, and confluent punctate.

Head with a thick covering of scales down to the antennal sockets and a more or less distinct median line, ending in a little ridge over the polished lower front, punctation coarse and tending to be in confluent lines; lower front not very densely or coarsely punctate with a fine scale arising from each puncture; an indistinct ridge on either side of occiput. Antennae reddish brown and not extending much below the humeri, with the distal joints thickened, of the usual proportions. Prothorax not quite so long as wide, smoothly convex with a 3-toothed margin and a tooth at each corner; depressed along the basal margin; punctation coarse, deep, and confluent. Elytra with no sign of basal callosities, depressed along the basal margin; the rows of elytral punctures closely placed; punctures coarse and deep, becoming finer toward apex; scales closely appressed, rather coarse and yellowish mixed with brown so as to give the elytra a speckled appearance. Body beneath shining, breast and abdomen dark brown, tip of abdomen reddish, scales on this white and more slender; first abdominal segment coarsely and densely punctate; a small rounded depression at tip of abdomen of female, a more triangular depression in male. Hind femora bluntly toothed, anterior tibiae with a sharp tooth on inner side. Length 4.7 to 6.5 mm; width 2.2 to 3.2 mm.

*Type and paratypes.*—In the United States National Museum, collected by G. P. Engelhardt.

*Type locality.*—St. Augustine, Fla.

*Other localities.*—FLORIDA: Capron, Childs, Enterprise, Ponce de Leon, Rock Bluff, Weirsdale, Winter Park; GEORGIA: SOUTH CAROLINA: Meredith, Myrtle Beach, Ridgeland; NORTH CAROLINA: Boardman (W. F. Fish, on *Toxodinium distichum*); VIRGINIA: Fredericksburg; ALABAMA: Mobile; MISSISSIPPI: Hancock; LOUISIANA: Pearl River.

*Remarks.*—Its reddish-brown coloring and yellowish scales differentiate this species from *denticollis* and *ranella*. The prothorax is more coarsely punctate than in *denticollis* and is also more convex. It looks like a small specimen of *M. magnus* but has a much more coarsely punctate prothorax and is a deeper reddish brown.

MYOCHROUS FLORIDANUS TEXANUS, new subspecies

PLATE 2, FIGURE 7

Two specimens in the Hubbard and Schwarz collection from Columbia, Tex., do not agree entirely with the other specimens of *M. floridanus*. They are a little smaller and have a more finely punctate prothorax, the punctures being more confluent and denser and

not so deep. The punctures on the elytra appear a little less spaced. The aedeagus seems to have a little less rounded tip with a slightly broader point. The aedeagus resembles somewhat that of *M. tibialis* Jacoby, from Mexico, which is another of the reddish-brown species, but which is larger and flatter with less dense punctuation.

*Type and paratype*.—Type male and one paratype, U.S.N.M. No. 59023.

*Type locality*.—Columbia, Tex.

#### MYOCHROUS MAGNUS Schaeffer

##### PLATE 2, FIGURE 4

*Myochrous magnus* SCHAEFFER, Journ. New York Ent. Soc., vol. 12, p. 228, 1904.

From 6 to 8 mm. in length, elongate oblong, deep reddish brown, shining under the dense and closely appressed yellowish scales; prothorax almost as long as wide, 3-toothed, punctuation not very coarse and not confluent, but dense; elytral punctuation fine and well spaced.

Head with a depressed furrow from occiput down front, and a ridge on either side of occiput; thickly covered with scales only slightly less dense on the lower front; surface beneath scales obsoletely and rugosely punctate. Antennae yellowish or reddish brown, extending to below the humeri, of the usual proportions. Prothorax almost as long as wide, rather inconspicuously 3-toothed with a tooth also at apical and basal angles; smoothly convex with a slight depression along the basal margin and often a small median parting on anterior margin over the furrow on the head; disk densely and not coarsely or confluent punctate. Elytra with prominent humeri, with a basal callosity and sulcus within the humerus and transverse depression below the callosity, in some specimens two indistinct costae running down over the basal callosity on each elytron; punctuation not visible through the dense and closely appressed scales, which are rather coarse and yellowish with a few slightly darker scales intermixed; the punctuation beneath unusually fine and well spaced. Body beneath rather densely covered with finer scales, in dark specimens the abdomen dark with the tip usually reddish. Hind femora with a blunt tooth, anterior tibiae with the usual tooth on the inner side. Length 6 to 8 mm.; width 2.5 to 3.4 mm.

*Type*.—In the United States National Museum.

*Type locality*.—Esperanza Ranch, Brownsville, Tex.

*Other localities*.—MISSISSIPPI: Brookhaven (on elders); LOUISIANA: 10 miles up the river from New Orleans (on willows); TEXAS: Columbus. Also intercepted on fruit from Mexico.

*Remarks*.—This species, described from Brownsville, Tex., is the largest species of *Myochrous* in the United States. It is probably common in northern Mexico, as it has been intercepted in fruit from

there at ports of entry. The two specimens in the collection of the National Museum from north of New Orleans and at Brookhaven may have been introduced in shipments of fruit to New Orleans. It is one of the reddish-brown species and easily recognized because of its size and relatively fine punctation.

MYOCHROUS TIBIALIS Jacoby

PLATE 2, FIGURE 8

*Myochrous tibialis* JACOBY, *Biología Centrali-Americana*, Coleoptera, vol. 6, pt. 1, p. 175, 1882.

From 5 to 7 mm. in length, elongate oblong, deep reddish brown, densely covered by yellowish or pale brownish scales, prothorax 3-toothed, a little wider than long, moderately coarsely punctate, the punctures usually being well spaced and not at all contingent. Aedeagus short and with a hollowed-out, pointed tip.

Head densely covered by closely appressed scales to antennal sockets, surface beneath the scales densely and rugosely punctate, with a faint trace of median line and the usual ridge on either side of occiput; lower front shining and with less dense pubescence. Antennae reddish brown, of the usual proportions. Prothorax a little wider than long, smoothly convex without elevations or depressions except a slight median depression at base over the scutellum, with three small lateral teeth, also a tooth at apical and basal angles; punctures beneath the dense, closely appressed scales moderately coarse and dense but not at all confluent. Elytra with a small basal callosity and a transverse depression below it; rather densely covered by closely appressed scales, striae punctation beneath coarse and regular with some transverse ridging. Body beneath shining beneath the finer white scales, first abdominal segment sparsely and finely punctate. Hind femora very obscurely toothed, anterior tibiae with the usual inner tooth. Length 5 to 7 mm.; width 2.2 to 2.8 mm.

*Cotypes*.—In the United States National Museum, Museum of Comparative Zoology, and British Museum of Natural History (?).

*Type locality*.—In an endeavor to exclude other species that may be included in Jacoby's material, I hereby designate the type locality as Panzos, Vera Paz, Guatemala, Champion collector.

*Other localities*.—MEXICO: (Some undesignated localities, beetles in banana debris from Mexico), Santa Lucrecia, Tehuantepec; HONDURAS (in banana debris); GUATEMALA; NICARAGUA; PANAMA (all from banana debris). Specimens in Jacoby's *Biología* material from BRITISH HONDURAS: Belize, Río Hondo (Blancaneau); GUATEMALA: Cubilguitz, Lanquin (Champion). A specimen sent by the British Museum as Jacoby's *melancholicus* (synonymized with *carinatus* by Bryant) from Frontera, Tabasco, Mexico, Höge collector.

*Remarks.*—This is one of the reddish-brown species with pale yellowish or brownish scales. It resembles *M. magnus* Schaeffer but is a more coarsely punctate species with a shorter aedeagus, which, however, is very similar to that of *magnus* in the shape of its tip. Most of the specimens in the National Museum collection are without exact locality labels, having been taken at ports of entry in shipments of bananas. It would appear that the species ranges from Mexico to Panama.

## MYOCHROUS LONGULUS LeConte

## PLATE 3, FIGURE 5

*Myochrous longulus* LeConte, Proc. Acad. Nat. Sci. Philadelphia, 1858, p. 86.

From 4.5 to 5.5 mm. in length, narrowly oblong, shining black with a bronzy or coppery luster, legs and antennae reddish, covered with long, coarse, flatly appressed, brown and white scales which are easily rubbed off; prothorax fully as long as wide and 3-toothed; elytral punctures becoming much finer and less dense from the middle to the apex; anterior tibiae inconspicuously toothed.

Head rounded and covered by scales down to the antennal sockets, no evidence of occipital ridges or of a median depression, surface finely and rather densely punctate, not at all rugose; lower front shining, with small scattered punctures and a few finer scales. Antennae extending below humeri, third joint longer than fourth, reddish brown, distal joints thicker. Prothorax fully as long as broad with three lateral teeth, smoothly convex, without humps or depressions; punctation dense, moderately coarse and not confluent, without ridgings, usually hidden by the flat, coarse, brown and white scales. Elytra a little wider than thorax with small humeri and short intra-humeral sulcus; rows of punctures not contingent, punctures becoming much finer and less dense from the middle to the apex; scales broad and flatly appressed and forming an irregular brown and white color pattern. Body beneath dark, shining with a bronzy luster, thickly covered by scales, a little less coarse than on upper surface; first abdominal segment densely and finely punctate; the male with a little depression at the tip of abdomen, in female this depression less marked. Hind femora without toothing, anterior tibiae with an inconspicuous tooth on the inside. Length 4.4 to 5.7 mm.; width 1.9 to 2.5 mm.

*Type.*—In LeConte collection, Museum of Comparative Zoology.

*Type locality.*—Yuma, Ariz.

*Other localities.*—ARIZONA: Dome, Ehrenberg, Gila Bend (in alfalfa), Somerton (in cottonfield), Stafford, Tempe; CALIFORNIA: Blythe, Brawley, El Centro (on *Pluchea sericea*, injuring cotton, and on alfalfa); Holtville, Los Angeles County, Mexicale, Needles, Pot-holes, San Diego County, east shore of Salton Sea, ex plane San



Pedro, Winterhaven (on *Melilotus indica*); COLORADO: Grand Junction; IDAHO: Blackfoot (on sugar beets); BAJA CALIFORNIA: Calexico.

*Remarks.*—This slender, elongate species with long, coarse scales is not easily confused with any other. Apparently it has an unusually long range, occurring from Arizona to Idaho, and west to California and Lower California. E. A. McGregor<sup>15</sup> reports that beetles have done severe injury to cotton in Yuma, Ariz.; 500 acres had to be replanted twice following complete destruction of seedling plants, and finally planting was abandoned. Adults were seen feeding on the subterranean stems of arrowweed (*Pluchea sericea*), trailing mallow, and *Baccharis* sp., this being the first time the field was sown to crops. Previously almost a pure stand of arrowweed had been there.

MYOCHROUS WHITEI, new species

PLATE 3, FIGURE 4

From 3.5 to 5 mm. in length, elongated oblong, black, shining with a bronzy luster under the dense, broad, pale brown and white scales, scales easily rubbed off; prothorax as long as wide, inconspicuously 3-toothed, elytra with rows of rather small punctures, not very closely placed and finer toward apex.

Head rounded over the occiput, with a depressed median line half-way down the front, occipital ridgings not present, punctures beneath the scales, which cover the head down to antennal sockets, fine and dense and in lines on the occiput; lower front shining, with fewer and finer scales and sparse punctation. Antennae extending below the humeri, reddish brown with darker and thicker distal joints, of the usual proportions. Prothorax fully as long as wide, rather inconspicuously 3-toothed, with a small tooth at apical and basal angles; evenly convex, without humps or depressions; surface densely, finely, and not confluent punctate, the punctures somewhat elongate with a tendency toward arrangement in lines and thickest in the middle, entirely covered by the closely appressed, wide, brown-and-white scales. Elytra with small humeri and short intrahumeral sulcus; no distinct basal callosities; punctures not very coarse and becoming finer and sparser in apical half; scales dense, flatly appressed and wide, usually pale but frequently presenting a pale brownish vittation, with the apex usually brown. Body beneath black, shining with a metallic luster; legs and abdomen less densely covered by finer pale scales, abdomen finely punctate; a small depression at tip of abdomen in the male, less marked in the female. Hind femora not toothed, anterior tibiae very indistinctly toothed. Length 3.6 to 5.1 mm.; width 1.6 to 2.3 mm.

*Type and paratypes.*—Type male and 12 paratypes, collected March 19, 1931, by E. P. Van Duzee, California Academy of Sciences; 2 paratypes, U.S.N.M. No. 59022.

<sup>15</sup> Journ. Econ. Ent., vol. 10, p. 504, 1917.



*Type locality*.—Coalinga, Fresno County, Calif., Boy Scout Camp.

*Other localities*.—Los Banos, Calif. (E. P. Van Duzee, May 23, 1918); 2 miles east of Cressey, Merced County, Calif. (B. E. White, Sept. 13–18, 1940).

*Remarks*.—Although closely related to *M. longulus* LeConte, this species seems quite distinct. It is smaller and a little more convex, with shorter elytra and paler scales. The aedeagus is less acutely tipped than that of *M. longulus*. So far it has been collected only in the San Joaquin Valley of California, which is farther north than *longulus* has been found. Burdette E. White, for whom it is named, had collected the beetles in numbers and set them aside to describe as new. He writes that he found them “on the outer fringe of a sandy marsh consisting of two or three species of reeds and a ‘salt grass,’ probably Bermuda grass, from which most of the specimens were swept. This marsh is green nearly the year around, as the water source is from an artesian flow, adjacent to the Merced River.”

MYOCHROUS FEMORALIS Jacoby

PLATE 3, FIGURE 8

*Myochrous femoralis* JACOBY, Biologia Centrali-Americana, Coleoptera, vol. 6, pt. 1, p. 175, 1882.

From 5 to 7 mm. in length, oblong, dark piceous, shining with a bronzy luster through the grayish and brown scales, prothorax broad, 3-toothed, densely but not confluent punctured with round deep punctures.

Head covered with brown and gray scales down to the antennal sockets, no distinct median line, the punctures tending to be in lines, and the surface beneath the scales rough, a ridge on each side of occiput. Antennae reddish brown, of the usual proportions. Prothorax somewhat wider than long, smoothly convex with a slight median basal depression over the scutellum; the three lateral teeth well developed, and the usual apical and basal teeth; surface densely but not confluent or rugosely punctate, the punctures being round, deep, and not very coarse. Elytra without marked depressions, smoothly convex, covered by dense gray and brown scales, not entirely concealing the punctation below, the scales somewhat curved and not too closely appressed. Striate punctures regular, without ridging. Body beneath covered lightly with fine white scales, punctures on first abdominal segment coarse and moderately dense. Hind femora distinctly toothed, anterior tibiae with the usual tooth. Length 5.2 to 7 mm.; width 2.5 to 3 mm.

*Type*.—A single specimen in the British Museum, collected by Blancaneaux.

*Type locality*.—British Honduras, River Sarstoon.

*Other localities*.—NICARAGUA, Escondido River, 50 miles from Blue-

fields, collected by C. W. Richmond; HONDURAS: "Honduras or Panama"; GUATEMALA; MEXICO, Córdoba (Knab). (Most of the specimens are from banana trash in shipments of fruit without exact localities.)

*Remarks.*—One of the specimens presented to the United States National Museum from the original Biologia material under the name *Myochrous tibialis* Jacoby bears the same locality label, British Honduras, River Sarstoon (Blancaneaux), as is given by Jacoby for the single type specimen of *M. femoralis*. It is not the same species as the others in the Biologia material of *tibialis* and appears to fit very well Jacoby's description of *femoralis*. Dr. P. J. Darlington has compared my drawing of this specimen with the type of *femoralis* in the British Museum and states that the type of *femoralis*, like my drawing, is wider than *tibialis* and has toothed hind femora, and the punctuation of the pronotum and elytra also correspond; also that the pubescence of *femoralis* does seem grayer and less yellowish than *tibialis*. He concludes that I am probably right in referring this specimen to *femoralis*.

Jacoby himself stated that it differed from *tibialis* in having subdentate posterior femora and being without the transverse ridging of the elytra. If my interpretation is correct, this species appears to be abundant throughout Nicaragua, Guatemala, and Honduras. Specimens have been brought in with shipments of bananas from these countries. It is a broadly oblong beetle with a wide prothorax that is densely and deeply but not at all rugosely punctate.

MYOCHROUS COENUS, new species

PLATE 3, FIGURE 6

From 5 to 6 mm. in length, oblong, dark piceous, shining with a bronzy luster from beneath the moderately dense, yellowish and brownish scales, the scales not concealing the sculpture beneath; prothorax wider than long, 3-toothed, densely and coarsely punctate, elytra without definite transverse ridgings or callosities.

Head covered by scales to the antennal sockets, beneath the scales coarsely and rugosely punctate, a faint median line in some specimens, and the usual occipital ridge on each side of head. Antennae reddish brown with deeper colored outer joints, of the usual proportions. Prothorax wider than long with three well-developed teeth and a tooth at apical and basal angles; disk not very convex, rather flat, with a depression along basal margin; punctuation dense, coarse, and deep but not confluent, a slight tendency toward ridging in basal part where the punctures usually become denser. Elytra without distinct callosities or depressions, regularly striate punctate without any transverse ridging; scales not so dense and closely appressed as to hide the punctuation. Body beneath shining under the light, fine, white pubescence,

first abdominal segment coarsely and rather densely punctate. Anterior tibiae with the usual tooth and hind femora bluntly toothed. Length 5 to 6.2 mm.; width 2.4 to 2.8 mm.

*Type and paratypes*.—Type male and three paratypes, collected by A. H. Jennings in April 1911, U.S.N.M. No. 59013; one paratype in Museum of Comparative Zoology.

*Type locality*.—Gatun, Canal Zone, Panama.

*Other localities*.—Miraflores, Canal Zone, December 28, 1925, collected by White and Clayton; Old Panama, January 1911, A. Busck.

*Remarks*.—This is not a very distinctive species and can best be recognized by the genitalia. Superficially the beetles are much like *M. platylonchus* with which they commonly occur in the Canal Zone. The shape of the aedeagus, however, is very different, resembling that of *M. femoralis* Jacoby but smaller. The thoracic punctation is not so dense or regular as in that species and the beetles are a little smaller, but the two species are closely related.

#### MYOCHROUS BARBADENSIS Blake

##### PLATE 3, FIGURE 7

*Myochrous barbadensis* BLAKE, Proc. Ent. Soc. Washington, vol. 49, p. 27, 1947.

From 5 to 6.5 mm. in length, elongate oblong, deep reddish brown to piceous black, shining with a bronzy luster beneath the yellowish, not closely appressed scales; thorax 3-toothed, coarsely but not very densely punctate; elytral scales not so dense as entirely to conceal punctation beneath. Tip of aedeagus with an unusually broad point.

Head covered by yellowish scales down to antennal sockets, lower front with finer, sparser, white hairlike scales; a median depressed line down occiput and dense deep punctures over upper head making the surface rugose; the usual occipital ridges on each side. Antennae reddish or yellowish brown, of the usual proportions. Prothorax a little wider than long, with three well-developed lateral teeth and the usual one at apical and basal angle, moderately convex, with a depression along the basal margin most pronounced over the scutellum; surface coarsely and deeply but not densely punctate, with the scars of scales forming shallow punctures between. Elytra not so densely scaly as to hide the luster and punctation beneath; punctures very coarse and closely placed, with a tendency to transverse ridging in depression below the basal callosities. Body beneath very shining, with sparse, short, white hairlike scales, first abdominal segment not very coarsely or densely punctate. Tip of last segment of male with a triangular, of female with a rounded, pit. Hind femora bluntly toothed, anterior tibiae with the usual inner tooth. Length 5 to 6.5 mm.; width 2.3 to 2.8 mm.

*Type and paratype*.—Type male and one paratype female, U.S.N.M. No. 57998, collected March 14, 1936, by R. E. Blackwelder.

*Type locality*.—Barbados, British West Indies.

*Other localities*.—GRENADA, B. W. I.: St. Augustine; TRINIDAD (P. J. Darlington, April 1929); BRITISH GUIANA: Botanic Garden, Georgetown (Harold Morrison, May 1–26, 1918); DUTCH GUIANA: Rust en Werk, Surinam (eating young leaves of bananas; D. C. Geijskes, January 30, 1931).

*Remarks*.—The aedeagus of this species bears a close resemblance to those of *M. femoralis* Jacoby and *M. coenus* but has the broadest tip of any of them. All three species are very similar in outward appearance, but this one is usually less densely punctate on the prothorax. Originally described from Barbados, it has been collected on both Grenada and Trinidad as well as on the mainland, in the Guianas.

MYOCHIROUS LATISETIGER, new species

PLATE 3, FIGURE 2

From 5 to 6 mm. in length, oblong, piceous with a bronzy luster beneath the dense, curved, dark brown and white scales, the scales unusually broad and not flatly appressed; head, thorax, and elytra coarsely and densely punctate; prothorax broad, smoothly convex, and with three well-developed teeth.

Head coarsely, rugosely, and densely punctate beneath the scales, with a faint median line, the ridge on either side of occiput present. Antennae reddish brown, of the usual proportions. Prothorax broader than long, with three strong lateral teeth and one at apical and basal angles; a depressed line across base, disk moderately convex; punctation dense, deep, round, and becoming rugose toward base. Elytra with a small humeral prominence and short intrahumeral sulcus, and below this a transverse depression on the sides; striate punctation unusually coarse and contiguous, transversely ridged in basal half; scales on entire upper surface wider than in most species and not appressed but curved. Body beneath shining beneath the much finer pale pubescence; first abdominal segment coarsely punctate. Hind femora with an indistinct tooth, anterior tibiae with the usual inner tooth. Length 5.2 to 6.2 mm.; width 2.5 to 2.8 mm.

*Type and paratype*.—Type male and one paratype, U.S.N.M. No. 59028, collected by F. L. Gallege in 1941, injuring the fruit of *Bixa orellana* Linnaeus.

*Type locality*.—Atlantico, Colombia.

*Other localities*.—Aracataca, Magdalena Province, Colombia (P. J. Darlington, 1929).

*Remarks*.—This is another species of the *femoralis* group in which the aedeagus, although with a similarly shaped tip, is shorter. Like the rest of the group, it is a coarsely punctate beetle but differs from them in having wider scales that are mostly dark brown with some paler ones intermingling.



## MYOCHROUS PLATYLONCHUS, new species

## PLATE 1, FIGURE 6

From 5 to 6 mm. in length, oblong, deep reddish brown to piceous, very shiny through the curved, not closely appressed yellowish scales, the scales not so dense as to conceal the sculpture, coarsely and densely punctate throughout; aedeagus with a scooplike tip, unusually broad.

Head covered with scales down to antennal sockets, an unusually deep median furrow down front ending in a broad shallow depression; surface under the scales coarsely and rugosely punctate, a ridge on either side of occiput. Antennae extending a little below the humeri, reddish brown, of the usual proportions. Prothorax considerably wider than long and somewhat contracted at the base, rather flat and with little convexity, a slight median depression over the scutellum; the three lateral teeth well developed; punctuation very dense, coarse, and becoming coarser and more confluent in the basal half with ridgings. Elytra smoothly convex without callosities and only a faint transverse depression on the side; striae punctures coarse and contingent with transverse ridgings visible through the moderate scaliness; elytra usually a little more reddish brown than the prothorax. Body beneath shining under the light fine scales, unusually coarsely punctate over the metasternum and first abdominal segment. Hind femora with a small tooth, anterior tibiae with the usual inner tooth. Length 4.8 to 6 mm.; width 2.2 to 2.7 mm.

*Type and paratypes*.—Type male and 24 paratypes, U.S.N.M. No. 59020, collected January to April 1911 (E. A. Schwarz, A. Busck, A. H. Jennings); 2 paratypes in Museum of Comparative Zoology.

*Type locality*.—Paraiso, Canal Zone, Panama.

*Other localities*.—CANAL ZONE: Las Cruces (E. A. Schwarz and A. Busck); Bohio (E. A. Schwarz); Corazal (A. Busck); Tabernella (A. Busck); Gatún (M. Hebard); PANAMA: Trinidad River, Colorado Island (J. D. Hood and N. S. Scrimshaw); Old Panama (A. H. Jennings); Panama (A. H. Jennings); COLOMBIA: Aracataca, Magdalena Province (P. J. Darlington, 1929); Buenaventura (C. L. Fagen).

*Remarks*.—This species has been collected in numbers throughout the Canal Zone. A number of specimens have been taken also by P. J. Darlington in northern Colombia and one by C. L. Fagen well down the coast of western Colombia. It is a shiny, deep reddish-brown or bronzy beetle with a very coarsely punctate prothorax and a most distinctive aedeagus, the tip of which is wider than usual in the genus and scoop-shaped.

## MYOCHROUS GEMINUS, new species

## PLATE 1, FIGURE 8

About 5 mm. in length, oblong, piceous, shining with a bronzy luster from beneath the curving grayish white scales; prothorax 3-



toothed, very densely and toward the base coarsely and rugosely punctate; aedeagus similar to that of *M. platylonchus* in having a broadly hollowed-out apex.

Head covered with scales down to antennal sockets, beneath these the punctures coarse and tending to be rugosely striate; a median line ending in a shallow depression between the eyes, the usual pair of occipital ridges. Antennae reddish brown and of the usual proportions. Prothorax wider than long, not very convex, with a basal depression along margin, the three lateral teeth well developed, and a tooth at apical and basal angles; punctation dense, tending to be in short lines, and becoming coarser and rugose toward the base. Elytra with a short intrahumeral sulcus and slight transverse lateral depression below the sulcus; striate punctures very close and coarse and in basal part in the depression with transverse ridging; surface lustrous beneath the curved, not dense, grayish-white scales. Body beneath shining, with fine pale pubescence, first abdominal segment coarsely and densely punctate. Hind femora with a tiny tooth, anterior tibiae toothed. Length 4.8 to 5.5 mm.; width 2.2 to 2.5 mm.

*Type and paratypes*.—Type male and one paratype, U. S. N. M. No. 59021, "in banana debris from Ecuador," April 13, 1947; one paratype in Museum of Comparative Zoology.

*Type locality*.—"Taken from banana debris from Ecuador" at New Orleans, La.

*Other locality*.—PERU: Piura.

*Remarks*.—Although quite distinct from *M. platylonchus*, this species belongs to the same group. It is about the same size, a little darker in color, with grayish instead of yellow scales. It has the same dense rugose punctation, the shape of the prothorax is similar, and the aedeagus is strikingly like that of *platylonchus* in shape, both when viewed from the side and in the broadly scooped-out tip, although the tip is a little narrower. The pubescence is thicker and paler in *geminus*. Two specimens from Piura, Peru, collected by P. A. Berry in cotton buds, October 15, 1941, are apparently the same.

MYOCHROUS ELACHIUS, new species

PLATE 4, FIGURE 3

From 4.5 to 5 mm. in length, oblong, shining bronze beneath the closely appressed, mottled pale and dark brown scales; prothorax 3-toothed, a little wider than long, not very coarsely but densely punctate; aedeagus pale with a dark furrow running down the tip.

Head covered with scales down to antennal bases, beneath the scales the punctation not dense or rugose, the usual occipital ridge on each side, and in some specimens a faint median line. Antennae reddish brown, of the usual proportions. Prothorax a little wider than long with three lateral teeth and a tooth at basal and apical angles, moderately convex with a depressed line along the basal margin; puncta-

tion under the dense scaliness not very coarse and well spaced but dense. Elytra with a short intrahumeral sulcus and basal callosity on each side of scutellum, and a slight depression on the outer side of elytra below the humerus; striate punctation regular, without transverse ridgings; pubescence dense, nearly concealing the bronzy surface beneath, and presenting a mottled brown and white appearance. Body beneath shining bronze with a fine pale pubescence, punctures on first abdominal segment moderately dense and fine; an indistinct blunt tooth on posterior femora, anterior tibiae with the usual tooth on inner side. Length 4.4 to 5.2 mm.; width 2 to 2.3 mm.

*Type and paratypes*.—Type male and three paratypes, U.S.N.M. No. 59014, collected by E. A. Schwarz and A. H. Jennings; one paratype in Museum of Comparative Zoology.

*Type locality*.—Ancon, Canal Zone, Panama.

*Other localities*.—CANAL ZONE: Gatún and Paraíso (A. H. Jennings); PANAMA: No specific locality (E. A. Schwarz); Tabernilla (A. Busck); found in banana debris in shipments from Honduras, Nicaragua, Guatemala, and Mexico. One specimen collected by H. Dybas at Puerto Berrio, Colombia, cannot be distinguished from the specimens from Central America.

*Remarks*.—Its small size and mottled appearance, a result of the intermingling of pale and dark brown scales, readily distinguish this little beetle from the larger ones having more uniform clothing. The aedeagus is peculiar in being pale yellowish with a dark streak down the furrow at the tip.

#### MYOCHROUS PAULUS, new species

#### PLATE 4, FIGURE 4

From 4 to 5.5 mm. in length, oblong, shining bronze beneath the closely appressed mottled brown and white scales; prothorax 3-toothed, densely and finely punctate, the punctures frequently becoming coarser and a little ridged in the middle of the base.

Head covered with brown and white scales down to the base of the antennae, beneath these a median depressed line and a distinctly punctate, rugose surface, with the usual occipital ridge on each side. Antennae reddish brown, of the usual proportions. Prothorax large, nearly as wide as elytra, broader than long, with three lateral teeth and the usual apical and basal tooth; disk evenly convex, depressed along base, surface finely and moderately densely punctate, the punctures becoming coarser at base and somewhat ridged in some specimens near the middle of the base. Elytra not so densely covered by the brown and white scales as to conceal the bronzy luster and striate punctures below; in basal half, especially in the transverse depression below the basal callosity, the surface ridged. Body beneath shining beneath the light pale pubescence, punctures on first abdominal

segment fine and not very dense. A distinct tooth on posterior femora and the usual tooth on anterior tibiae. Length 4.2 to 5.6 mm.; width 2.2 to 2.6 mm.

*Type and paratypes*.—Type male and 26 paratypes, U.S.N.M. No. 59015, collected in September and October 1918 by Harold Morrison; two paratypes in the Museum of Comparative Zoology.

*Type locality*.—Botanic Garden and along seashore 4 miles east of Georgetown, British Guiana.

*Other localities*.—BRITISH GUIANA: Bartica, Demerara (R. J. Crew); DUTCH GUIANA: Rusten Werk, Surinam (on bananas; D. C. Geyskes); FRENCH GUIANA: Maroni, Cayenne (F. Pillault); VENEZUELA: "L. Laglaize," Tucupita, Delta Amacuro Territory (on *Xanthosoma sagittifolium*; L. A. Salas); BRAZIL: Amazon River near Parintins (Sept. 12 to 21, 1930; Holt, Blake, and Agostini); Amazon River near Santarém, Santa Catharina (Bowditch collection); Baturité Mountains, Ceará (W. M. Mann); Natal, Pará (W. M. Mann).

*Remarks*.—This species is closely related to the Central American species *M. elachius* and differs from it chiefly by being a little wider and more finely punctate and in having the aedeagus not hollowed out at the tip, as in *M. elachius*.

#### MYOCHROUS NANUS, new species

#### PLATE 4, FIGURE 5

About 4.5 mm. in length, oblong, shining bronze beneath the mottled brown and white scales; prothorax 3-toothed, finely and sometimes densely punctate, elytra with the striate punctures becoming much finer and more distantly placed in apical half of elytra.

Head covered by scales to the antennal bases, punctation somewhat variable, in some specimens the surface rugose, in others less densely punctate, with a trace of a median line and the usual ridge on each side of the occiput. Antennae reddish brown, of the usual proportions. Prothorax wider than long, with three lateral teeth and a tooth at apical and basal angles; disk evenly convex with a depressed line marked by a row of punctures along the basal margin; punctation rather sparse and fine, in some specimens much denser than in others. Elytra with a well-marked depression below the basal callosity; striate punctures in basal half moderately coarse but not dense and becoming much finer in apical half; a tendency to transverse ridging in the depression below the callosities. Body beneath shining bronze with sparse pale pubescence; punctation of first abdominal joint fine and not dense. Posterior femora with a tiny tooth, anterior tibiae with the usual tooth. Length 4.1 to 4.7 mm.; width 2 to 2.3 mm.

*Type and paratypes*.—Type male and two paratypes, Museum of Comparative Zoology type No. 28121, collected by Germain. One paratype, U.S.N.M. No. 59016.

*Type locality*.—Cochabamba, Bolivia.

*Other localities*.—BOLIVIA: Rurrenabaque, Beni River (W. M. Mann, Mulford Biological Expedition, 1921-22); PARAGUAY: San Salvador (Dr. Bohls).

*Remarks*.—The sparser elytral punctation beneath the mottled brown and white scales distinguishes this from the two preceding species. The aedeagus also has a differently shaped broader tip. These three little species present a very similar appearance and are undoubtedly closely related. The most northern one has been collected from Mexico to Colombia, the second one ranges from the Guianas down to the Amazon, and the third has been taken in Bolivia and Paraguay. Their chief differences are in punctation and the shape of the aedeagus.

MYOCHROUS RHABDOTUS, new species

PLATE 4, FIGURE 2

About 6.5 to 7 mm. in length, elongate oblong, shining bronzy black beneath the wide, pale brown scales, prothorax not very convex, sparsely punctate, with three well-developed lateral teeth, elytra with faint vittate markings either as the result of slight costae beneath or faintly deeper brown scale coloration.

Head covered with scales down to antennal sockets, the usual ridges on each side of occiput and a median line half down the front; punctation moderately dense and coarse, not rugose. Antennae of the usual proportions, deep reddish brown. Prothorax almost as long as wide, not very convex, depressed along the base, lateral sides with three large teeth as well as an apical and basal tooth; punctation fine and not dense in anterior portion, becoming denser and coarser toward base; scales about as broad as long, closely appressed, pale brownish. Elytra without distinct basal callosity, punctures coarse but well spaced, even in basal half, and becoming finer and more distant toward apex; three faint longitudinal costae and the scales covering them appearing slightly deeper brown, giving the elytra a faintly vittate appearance. Body beneath shining with bronzy luster, much less covered by scales, the scales finer and more hairlike. Hind femora bluntly toothed, anterior tibiae with the usual inner tooth. Length 6.5 to 6.9 mm.; width 2.6 to 3 mm.

*Type and paratypes*.—Type male and two paratypes, Museum of Comparative Zoology type No. 28122, collected by P. J. Darlington in April 1929; one paratype, U.S.N.M. No. 59018.

*Type locality*.—St. Augustine, Trinidad.

*Other localities*.—BRAZIL: Santa Catharina (Bowditch collection); TRINIDAD: "Trinidad," on sugarcane; D'Abadie; Golconda estate, San Fernando; Aripo savanna, all collected in October 1918 by H. Morrison.



*Remarks.*—This species is characterized by the faintly vittate elytra and the unusually broad and heavy aedeagus. The scales are about as long as broad.

MYOCHROUS DARLINGTONI, new species

PLATE 8, FIGURE 3

From 6 to 7 mm. in length, elongate oblong, piceous beneath the broad brown-and-white scales, with deep reddish-brown antennae and legs, the scales forming a brown-and-white pattern on the thorax and elytra, with the sides of the thorax and median line pale, a pale, incurving band from the humerus down the elytron and a pale transverse apical band, neither reaching the suture; thorax 3-toothed, approximately as long as wide and more convex anteriorly.

Head densely covered by wide scales even down to the base of the jaws, the usual ridges on either side of occiput, surface beneath the scales densely and deeply but not rugosely or confluent punctate. Antennae reddish brown, of the usual proportions. Prothorax as long as wide, strongly convex in anterior half and smoothly rounded over the middle, with a thickened anterior margin over occiput having a faint median notch, and a depression behind, also depressed along the basal margin; sides with three tiny teeth and a tooth at basal and apical angles; punctation deep but not very dense and moderately coarse, completely hidden by the broad brown and white scales; these scales forming a pattern in which the median line and sides are white, some of the scales deeper chocolate brown. Elytra with a similar sort of pattern, consisting of a long incurving pale band from humerus down toward suture and another forming a transverse pale band not reaching the suture near the apex; sides more or less pale and the brown areas interspersed with deeper brown scales; striate punctation below entirely concealed by scales, but consisting of not coarse or contingent punctures becoming much finer toward the apex. Body beneath densely covered by broad white scales leaving little of the dark shining surface beneath visible. Hind femora not distinctly toothed, anterior tibiae with the usual inner tooth. Length 6 to 7 mm.; width 2.5 to 3 mm.

*Type and paratypes.*—Type male and three paratypes, Museum of Comparative Zoology type No. 28123, collected by P. J. Darlington in 1929; one paratype, U.S.N.M. No. 59019.

*Type locality.*—Aracataca, Magdalena Province, Colombia, collected by P. J. Darlington, in 1929.

*Other locality.*—COLOMBIA: New Granada.

*Remarks.*—Recognized by the narrow shape and unusual color pattern formed by the broad brown and white scales. The thickened anterior margin of prothorax is similar to that found in *M. bolivianus* and the *curculionoides* group. The shape of the aedeagus is rather unusual.



## MYOCHROUS BOLIVIANUS, new species

## PLATE 4, FIGURE 6

From 5.5 to 6.5 mm. long, broadly oblong, deep reddish brown, prothorax nearly half as long as elytra, with three tiny lateral teeth, and a thickened anterior edge covering occiput, densely covered with short, broad, pale brown and white scales forming a pattern with two to four white spots on elytra; punctation beneath scales fine, not dense.

Head somewhat receding, the occiput bulging and with the usual occipital ridges on either side, and in some specimens a well-marked median line down front ending in a depression, often almost a pit, in the middle of the front; labrum unusually small; head covered with dense, closely appressed scales down to antennal bases, beneath the scales the punctation rather fine and moderately dense. Antennae reddish brown, of the usual proportions. Prothorax large, almost as wide as elytra, and a little wider than long, convex, with a peculiar thickening along the anterior margin over the head, almost concealing the occiput from above, and a depression behind this; the lateral edge with three small teeth and a small apical and basal tooth; surface shining reddish brown or piceous with moderately fine, well-spaced punctures; a row along basal margin forming a depressed line; scales very dense, often forming a pattern with a white median line extending halfway down thorax and a broad white area on each side, this pattern, however, variable. Elytra rather convex, especially in the middle, with sharp humeral prominences and intrahumeral depression extending down below a slight basal callosity; surface very shining, deep reddish brown or piceous with rather small striate punctures becoming fine toward the apex. Scales forming a pattern in some specimens, having on each elytron a white spot before and after the middle and smaller lateral spots, these, however, variable. Body beneath fairly densely covered with somewhat thinner scales, covering the punctation; unusually long hairs between the anterior coxae. A blunt tooth on posterior femora, and a tooth also on inner side of anterior tibiae. Length 5.5 to 6.5 mm.; width 2.6 to 3 mm.

*Type and paratypes*.—Type male and seven paratypes, U.S.N.M. No. 59017, collected October 23 to November 9, 1921, by W. M. Mann, Mulford Biological Expedition.

*Type locality*.—Rosario, Lake Rogagua, Bolivia.

*Other localities*.—San Gregorio, Bolivia (W. M. Mann, October 1921).

*Remarks*.—This is an unusually distinctive species, characterized by its short, chunky shape and the markings of the scales. The thickened anterior margin of the prothorax is similar to that in the *curculionoides* group. It differs from these species in having a much broader prothorax which is nearly as wide as the elytra. Dr. Mann states that he collected it on the border of the lake.

## MYOCHROUS CHACOENSIS, new species

## PLATE 4, FIGURE 7

Approximately 7 mm. in length, broadly oblong oval, shining black, covered by pale white and brown scales forming on the elytra a semivittate pattern; thorax almost as long as broad, projecting over head with a thickened anterior margin; strongly convex with a 3-toothed lateral margin; surface rather finely and not very densely punctate; elytra with well-spaced punctation.

Head somewhat receding with a median vertical groove down front and a well-developed ridge on either side of occiput; the punctation covered by dense, closely appressed scales. Antennae pale, of the usual proportions. Prothorax almost as long as broad with the anterior margin thickened and also concealing the head, with a slight median impression over the occiput; strongly convex, depressed along the basal margin; sides 3-toothed; surface finely and not very densely punctate. Elytra twice as long as thorax, strongly convex with prominent humeri and at base two short costae, otherwise depressed along the basal margin; a slight transverse depression below the humeri; striate punctation not very coarse or dense and covered by the broad, closely appressed pale brown and white scales, the scales forming indistinct brown and white vittae. Body beneath shining black with fine white scales, the abdomen without scales down the middle, first segment finely and not very densely punctate. Tibiae reddish brown, anterior ones with a distinct tooth on inner side and another at apex. Length 6.9 mm.; width 3.3 mm.

*Type*.—A female in Miguel Lillo Institute, Tucumán, Argentina, collected by F. Monrós.

*Type locality*.—Resistencia, Chaco Province, Argentina.

*Remarks*.—As in the case of *M. stenomorphus* and *M. monrosi*, as well as of *M. spinipes* and *M. mamorensis*, this species, although separated by a thousand miles, has a close relative, *M. bolivianus*. In all three the closely related species resemble each other strongly but have minor differences. In this case, *M. chacoensis* is a bit larger and darker, with paler scales having a different color pattern on the lower surface as well as above.

## MYOCHROUS CURCULIONOIDES Lefèvre

## PLATE 5, FIGURE 5

*Myochrous curculionoides* LEFÈVRE, Ann. Soc. Ent. France, ser. 6, vol. 9, p. 21, 1899.—JACOBY, Entomologist, vol. 30, p. 263, 1897.

About 6 mm. in length, thorax much narrower than elytra, which are broadly oblong; deep reddish brown to piceous black, covered with broad yellowish scales, surface beneath coarsely and densely punctate, thorax strongly convex with two gibbosities on anterior margin and deeply sulcate between; sides with two, possibly more,

more or less distinct teeth; all femora strongly toothed; no tooth on inside of anterior tibiae.

Head covered by coarse yellow scales down to antennal sockets, surface below densely punctate, a small elevation where tubercles usually are; the usual ridge on each side of occiput. Antennae reddish brown, of the usual proportions. Prothorax as long as wide, strongly convex, an enlargement over the occiput consisting of an elevation with a deep median depression, this depression extending to a less marked degree down the middle of the thorax; surface beneath the coarse yellow scales with coarse, rugose, and often confluent punctures; sides with a prominent tooth anteriorly and a less prominent one in the middle and a trace of a third tooth on one side, also the usual apical and basal tooth. Elytra much wider than thorax, convex, with prominent humeri and a strongly marked basal callosity on each side of the scutellum; lateral margin distinctly serrate; surface with coarse, contingent, and somewhat irregularly shaped punctures, having transverse ridgings or wrinklins; scales at apex and sides forming a yellow band. Body beneath covered with coarse pale scales, all the femora distinctly toothed; anterior tibiae without the usual inner tooth. Length 6.5 mm.; width 3.2 mm.

*Type*.—I have examined the type, which is in the British Museum of Natural History.

*Type locality*.—Bahia, Brazil.

*Remarks*.—The unusual development on the anterior part of the prothorax distinguishes this from all other species. Otherwise the thorax resembles that of the two following species, which have only a slightly thickened anterior margin to the thorax. These three species are closely related and present striking differences from the rest of the genus in their strongly convex, narrow thorax with an anterior enlargement, as well as the more developed elytral callosities at the base, and the pale band at the apex. Two of the three have all the femora toothed.

The specimen sent me by the British Museum bears Jacoby's own label and contrary to both his and Lefèvre's description has two quite distinct teeth on the sides of the thorax and a trace of a third tooth on one side.

MYOCHROUS CRASSIMARGINATUS, new species

PLATE 5, FIGURE 2

From 6 to 7 mm. in length, dark piceous, sometimes with a faint greenish luster beneath the wide, closely appressed brown and white scales, thorax as long as broad with a thickened anterior margin over the occiput, with three lateral teeth (two of these usually inconspicuous); a distinct basal callosity on each elytron; punctation unusually fine; anterior tibiae and hind femora toothed.

Head covered by brown and white scales down to antennal sockets,

area between antennal sockets with a few fine white scales; the usual ridge on each side of the occiput, a median line down front; punctures small and well spaced. Antennae of the usual proportions, reddish brown. Prothorax as long as wide, strongly convex, with rather straight sides having three lateral teeth, two of which are inconspicuous, also one at basal and apical angles; along middle of the anterior margin, over the head, a thickening with a ridge running down at right angles at each end and between these, behind the margin, a depression; also a depression along the basal margin; punctation rather fine and dense, under the broad, closely appressed, brown and white scales, scales as broad as in *squamosus*. Elytra considerably wider than prothorax, convex, a sharp humeral prominence and unusually well-developed basal callosity on each side of scutellum over which a trace of costae; area about scutellum depressed; striae punctures small, well spaced, with a tendency to transverse ridging; punctures becoming finer toward apex; lateral margins serrate entire length; scales broad, closely appressed, with finer scales beneath; scales at apex mostly white. Body beneath lightly covered with a somewhat less coarse white scaliness, not coarsely punctate. Hind femora bluntly toothed and anterior tibiae toothed. Length 5.8 to 6.8 mm.; width 3-3.5 mm.

*Type and paratypes*.—Type male, Museum of Comparative Zoology type No. 28118; one paratype, U.S.N.M. No. 59137; three paratypes in the British Museum.

*Type locality*.—The only label on the type is "Jacoby 2nd collection" (in Bowditch collection), but apparently it belongs to the same series as those in British Museum, labeled "Cayenne," one in Thomson collection, one in Baly collection, and two, Laferté.

*Remarks*.—This is clearly very closely related to *M. curculionoides* Lefèvre. Although the anterior margin of the thorax has not so great a development, there is a pronounced thickening there. The punctation throughout is much finer and less dense. Unlike *curculionoides* this species has a tooth on the inner side of the anterior tibiae and the anterior femora are not toothed. There is a similar pale coloring of the scales at the apex of the elytra, but the scales are much wider than in *curculionoides* and resemble the scales of *M. squamosus*.

MYOCHROUS LEUCURUS, new species

PLATE 5, FIGURE 4

About 7.5 mm. in length, broadly oblong, shining black with a faint greenish or purplish luster beneath the broad, flatly appressed brown and white scales, scales forming a white band at apex of elytra; punctation dense, the elytra irregularly striae-punctate with many transverse wrinklins distorting the punctures; thorax much narrower than elytra, as long as broad, with a thickened anterior margin and angulate



(scarcely 3-toothed) lateral margin, strongly convex; anterior and posterior femora bluntly toothed, anterior tibiae with inner tooth.

Head covered with broad scales to the antennal sockets, below this the scales less dense and finer; surface beneath densely but not rugosely punctate, with a faint depressed median line and on each side of occiput a distinct ridge. Antennae reddish brown, the joints of the usual proportion (last four missing). Prothorax just about as long as wide, strongly convex, with a thickened anterior margin having on each side a narrow ridge running down a little way, and a slightly depressed area between the ridges, and behind the margin; sides more angulate than 3-toothed, with the usual basal and apical toothing; depressed along the basal margin; surface beneath the scales shining, densely and moderately coarsely but on the disk not rugosely punctate, the punctures on the sides running together in long striations with ridgings between. Elytra much wider than thorax, distinctly serrate along the sides, a pronounced basal callosity on each side of scutellum, and prominent humeri with a deep intrahumeral sulcus and a transverse depression below; punctation irregularly striate, the punctures dense and not round but distorted by the transverse wrinklins in basal half and on sides; scales broad, closely appressed, brown and white with a broad white band at apex and also along the sides. Body beneath not so densely squamulose, the scales not so wide, but closely appressed, first abdominal segment not coarsely punctate. Anterior and hind femora bluntly toothed; anterior tibiae with a strong inner tooth. Length 7.6 mm.; width 4 mm.

*Type*.—In Bowditch collection, Museum of Comparative Zoology type No. 28119.

*Type locality*.—Cayenne, "e coll. Chevt."

*Remarks*.—This is the largest of the three species in the *curculionoides* group, and unlike *curculionoides* it has a modified thickening of the anterior margin of the prothorax similar to that of *crassimarginatus*, and likewise has a tooth on the inner side of the anterior tibiae. The very wrinkled appearance of the elytra is unlike that of either of the other species. The punctures are not rounded but more stellate and irregular. As in the other two species, there are gibbosities at the base of the elytra and the scales at the apex are pale. Like them, too, the thorax is much narrower than the elytra.

#### MYOCHROUS ARMATUS Baly

##### PLATE 6, FIGURE 5

*Myochrous denticollis* BOHEMAN (nec Say), *Eugenies Resa*, *Insects*, p. 161, 1858.

*Myochrous armatus* BALY, *Trans. Ent. Soc. London*, ser. 3, vol. 2, p. 336, 1865.

*Myochrous bohemani* LEFÈVRE, *Ann. Soc. Ent. France*, ser. 6, vol. 4, *Bull.*, p. lxxvi, 1889.

From 6 to 7 mm. in length, broadly oblong, the thorax about half as long as the elytra, shining black with a slight bronzy luster beneath

the short, somewhat curved, brown and white scales, thorax 3-toothed, a little broader than long, densely covered by round deep punctures; aedeagus with an unusually long, slender point at the tip.

Head covered with brown and white closely appressed scales down to the antennal sockets, lower front with finer, sparser pubescence; densely punctured beneath and rugosely punctured over the occiput, front with a median furrow, the usual occipital ridge on either side. Antennae reddish brown of the usual proportions. Prothorax large, about one-half as long as the elytra, distinctly wider than long, moderately convex, depressed along the base, especially over the scutellum; punctures round, deep and dense, covered by short curved scales; the three lateral teeth well developed and the usual tooth at the basal and anterior angles. Elytra broad, with a slight basal callosity and a little tendency toward costation in basal half; striate punctation about scutellum deep and depressed, elsewhere punctures not very coarse and well spaced; the brown and white scales short, dense, and somewhat curved, not entirely concealing the sculpture. Body beneath shining piceous with a reddish brown tip to abdomen and dark reddish brown to piceous legs; first abdominal segment somewhat coarsely and often moderately densely punctate; scales fine and sparse. Hind femora toothed, anterior tibiae with the usual tooth on the inner side. Length 5.8 to 6.5 mm.; width 2.8 to 3.2 mm.

*Type*.—In British Museum.

*Type locality*.—Brazil.

*Other localities*.—BRAZIL: Rio de Janeiro, Rio Grande de Norte (W. M. Mann); URUGUAY: Maldonado (C. Darwin); Rivera (P. A. Berry); ARGENTINA: Buenos Aires Province: July to September 1919 (H. E. Box, also C. Burch); Delta Paraná, Carapecha (F. Monrós), Gálvez (F. Monrós), Luján, García, Punta Lara (F. Monrós), Capital Federal (F. Monrós); Güemes, Salta Province (H. A. Jaynes); Rio San Javier, Santa Fé (G. E. Bryant, May 1912), Santiago del Estero, Tucumán; Resistencia, Chaco, Martínez; Chile (collected by Germain).

*Remarks*.—Both *M. bohemani* Lefèvre and *M. armatus* Baly were described from Brazil a few years apart. I have examined a cotype of *M. armatus* and the type of *M. bohemani* (*denticollis* Boheman) and find them nearly identical in appearance. The large size, the very densely punctate thorax, which is approximately one-third the length of the beetle, and the exceptionally long attenuated tip to the aedeagus characterize this species. It appears to be well distributed over the southern part of South America.

MYOCHROUS BRYANTI, new species

PLATE 6, FIGURE 1

From 5.4 to 6.5 mm. in length, broadly oblong, deep bronzy black, thorax one-third the length of beetle, nearly as wide as elytra and

densely covered by round deep punctures becoming coarser toward base; elytra lacking any basal callosity, striate punctures near base unusually coarse and transversely ridged; scales exceptionally coarse, curved, and mottled brown and grayish.

Head covered by short brown and gray scales down to antennal sockets, surface below obsoletely punctate, an impressed median line down front, the usual occipital ridge on each side. Antennae of the usual proportions, reddish brown. Prothorax a little wider than long, almost as wide as elytra and one-third the length of the beetle, 3-toothed, moderately convex, with a depression along basal margin, densely and moderately coarsely but not confluent punctate, the punctures round and deep and a little coarser toward base. Elytra without any basal callosities, a short intrahumeral sulcus and a slight depression below the humerus; punctures very coarse and transversely ridged in basal portion, and hidden by the mottled brown and gray curved scales that are unusually coarse. Body beneath shining bronze under the fine white scales, first abdominal segment coarsely punctate. Hind femora bluntly toothed; anterior tibiae with the usual inner tooth. Length 5.4 to 6.5 mm.; width 2.6 to 2.9 mm.

*Type and paratypes.*—Type male and one paratype in British Museum, collected in November 1903, by G. E. Bryant; two paratypes in Museum of Comparative Zoology; one paratype, U.S.N.M. No. 59135.

*Type locality.*—Trinidad, British West Indies.

*Other localities.*—TRINIDAD: Capara Valley, Port of Spain, January 1897 (Dr. Rendall); 7 miles north of Moruga village (June 13, 1925, P. A. Andrews); Montserrat (June 29, A. Busck); Palo Seco (October 20, 1948, H. Morrison).

*Remarks.*—The large densely punctate thorax of this species resembles that of *M. armatus* Baly, but it is a shorter smaller species, with a shorter attenuated point at the tip of the aedeagus. All the nine specimens examined have come from Trinidad.

#### MYOCHROUS FIGUEROAE Brèthes

##### PLATE 6, FIGURE 3

*Myochrous figueroae* BRÈTHES, Nunquam Otiosus, vol. 4, p. 16, 1925.

"Subelongatus, nitidus, vix indistincte cupreo-nitens subtus modice magis cupreo- hic illic subaeneo-nitens, haud appresso fulvo-squamulatus, clypeo, antennis palpisque ferrugineis, his articulo ultimo piceo. Long. 6 mm.

"La tête et le pronotum ont une ponctuation assez grosse, non dense, le front avec une impression longitudinale. Le prothorax est plus long que large, le bord antérieur légèrement avancé en arc sur la tête, le bord postérieur avec une légère crête apicale et une impression pres de l'écusson, les bords latéraux avec trois petites dents mousses. Les élytres à peine plus larges et deux fois plus longues que le prothorax,



la ponctuation comme celle du pronotum, et serriée, les espaces non relevés; cependant le premier espace latéral est presque en crête aigue surtout près du callus. La ponctuation du dessous du corps est bien moins forte qu'en dessus; une forte impression médiane sous le 5 segment de l'abdomen. Les pattes sont subégales, les cuisses en massue, les tibias antérieurs avec une dent au côté inférieur vers le tiers apical.

"Un exemplaire recueilli à La Plata le 12, IV, 1923 par mon élève, Mr. Robert Figueroa López, qui est une vraie espérance pour l'Entomologie Argentine."

*Remarks.*—F. Monrós, of the Institute Miguel Lillo at Tucumán, Argentina, has sent me two specimens about which he writes as follows: "One species has been compared with one in Brèthes collection in Buenos Aires labeled *Myochrous platensis* which I believe is that one he later described as *M. figueroae* Brèthes, 1925. So this material could be homotypic." Both specimens unfortunately are females. In general appearance they resemble closely *M. armatus* Baly, but I believe they are not that species. The thorax is not so large and is not one-third the length of the beetle as is usual in most specimens of *M. armatus*. Furthermore, the punctuation of the thorax is more ridged toward the base and the punctuation of the elytra coarser and with less interspacing, and, except at the base, the rather pronounced costae usual in *M. armatus* are lacking. Both specimens were taken in the delta of the Paraná River, in Buenos Aires Province.

MYOCHROUS SAPUCAYENSIS, new species

PLATE 6, FIGURE 2

About 5.5 mm. in length, elongate oblong, shining black with short pale scales; thorax nearly as long as wide, not very convex, 3-toothed, very densely and coarsely but not rugosely punctate; elytra not much wider than thorax.

Head covered by short, closely appressed brown and white scales to antennal sockets, lower front with very short and indistinct scales or hairs, a median line down occiput and the usual ridge on either side. Antennae deep reddish brown, of the usual proportions. Prothorax not quite so long as wide, and about half as long as the elytra, rather flat, with a transverse depression anteriorly and a slight basal depression most marked in the middle, three well-developed lateral teeth and a small apical and basal tooth, surface very densely and deeply punctate, the punctures round and regular, not rugose or confluent, scales rather short and curved, in this single specimen examined much rubbed and not concealing the punctures. Elytra not much wider than thorax, with little trace of a basal callosity, a slight transverse depression in basal half; punctuation coarse, deep, and dense, with a little tendency toward transverse ridging in basal



portion; scales short, curved, brown and white (much rubbed). Body beneath with scanty fine pale hairs, first abdominal segment rather coarsely and densely punctate. Hind femora bluntly toothed; anterior tibiae with inner tooth. Length 5.6 mm.; width 2.6 mm.

*Type*.—A male, U.S.N.M. No. 59031, collected in March by W. T. Foster.

*Type locality*.—Sapucay, Paraguay.

*Remarks*.—This species resembles *M. armatus* Baly in having a broad and densely punctate prothorax, but is smaller and with finer sparser scales and a shorter tipped aedeagus.

MYOCHROUS NORMALIS, new species

PLATE 4, FIGURE 1

About 6 mm. in length, elongate oblong, shining piceous beneath the closely appressed gray scales, prothorax not very convex, with three large lateral teeth, coarsely, densely, and rugosely punctate.

Head covered by short, closely appressed scales down to antennal sockets, with a fine median line, rugosely punctate beneath the scales; occiput concealed in the single specimen examined. Antennae and mouthparts reddish brown; antennae extending below the humeri, of the usual proportions. Prothorax not quite so long as wide, not very convex, with a slight anterior depression and a basal depression most marked over the scutellum; sides with three well-developed teeth in addition to the apical and basal teeth; surface coarsely, densely, and rugosely punctate. Elytra without marked basal callosity, a faint trace of transverse depression on the side below the intrahumeral sulcus; striate punctures coarse, dense, but not ridged, showing through the short gray scales. Body beneath and legs not so deep in coloring and only sparsely covered with finer scales, especially the abdomen; first abdominal segment moderately coarsely punctate. Hind femora indistinctly toothed; anterior tibiae with the usual inner tooth. Length 6.3 mm.; width 2.9 mm.

*Type*.—A male, Museum of Comparative Zoology type No. 28120, collected by Dr. Bohls.

*Type locality*.—San Salvador, Paraguay.

*Remarks*.—This species is a typical *Myochrous* and similar to others of the genus with few distinctive features to mark it. It is smaller and more slender than *M. armatus* Baly and with a more rugosely punctate prothorax. The aedeagus is similar to that of many of the North American species, notably the West Indian species, but with a slightly shorter tip.

MYOCHROUS STENOMORPHUS, new species

PLATE 6, FIGURE 4

About 5 mm. in length, elongate oblong, reddish brown, covered above by short and broad, pale, closely appressed scales; thorax

strongly convex, as long as wide, with three minute lateral teeth, punctation dense and moderately fine, not confluent; elytra narrowly elongate.

Head covered by pale scales down to antennal sockets, the underlying punctation not visible, a faint depressed median line, and faint trace of occipital ridging in one specimen. Antennae orange brown, of the usual proportions and rather long. Prothorax as long as wide, smoothly and strongly convex, with a slight depression along basal margin, the sides feebly rounded, almost straight, armed with three minute teeth, and the usual basal and apical tooth; punctures dense but not confluent and not very coarse, surface not at all ridged. Elytra with small basal callosities and a transverse depression below; striate punctures moderately coarse in basal half without transverse ridging, almost completely hidden by the broad, pale, closely appressed scales. Body beneath less densely scaly, the abdomen with fine hairs, and the first segment finely punctate. Hind femora not distinctly toothed; anterior tibiae with small tooth on inner side. Length 4.9 to 5.0 mm.; width 2.3 mm.

*Type and paratype*.—Type in the British Museum, Baly collection; one paratype, U.S.N. No. 59136.

*Type locality*.—? Pampas, Argentina.

*Remarks*.—The British Museum has other specimens that I have not examined, presumably of this species. The old handwritten label on the two specimens that I have examined is faded and nearly illegible but it appears to be endorsed "Pampas." The beetles have a shape similar to that of the North American species *M. longulus* LeConte, being unusually narrow and elongate. The aedeagus is much longer than in that species and it has a longer tip.

#### MYOCHROUS MONROSI, new species

#### PLATE 6, FIGURE 6

Approximately 6.5 to 7 mm. in length, oblong, reddish brown, covered by pale brownish scales, prothorax as long as wide and nearly as wide as elytra, strongly convex, with three small sharp lateral teeth, densely and moderately coarsely punctate; elytra with dense, coarse punctation.

Head beneath the scales rough, with coarse shallow punctation, a faint medium vertical line, the usual ridge on either side of occiput not well developed. Antennae of the usual proportions. Prothorax fully as long as broad, strongly and evenly convex with nearly straight sides having three small sharp teeth not very conspicuous and with an unusually small apical and basal tooth; a slight basal depression over the scutellum and a thickening along the anterior margin over occiput; surface densely and shallowly punctate, the punctures tending to be elongated and in lines with interspaces alutaceous, not at all

shiny. Elytra over twice as long as prothorax and a little wider, moderately convex with small humeri and a short intrahumeral depression and little trace of basal callosities; punctation coarse, dense, and in basal half sometimes a little confused, otherwise striately punctate; two fairly well marked costae; scales short, closely appressed, moderately wide and presenting a somewhat mottled appearance, almost concealing the sculpture beneath. Body beneath less densely and coarsely pubescent, abdominal segments closely punctate. Length 6.6 to 6.9 mm.; width 3 mm.

*Type and paratype*.—Type female in Institute Miguel Lillo, Tucumán, Argentina, collected December 3, 1948, by F. Monrós; paratype, a male, U.S.N.M. No. 59225, collected at Ledesma, Jujuy Province, Argentina, December 1, 1948, by F. Monrós.

*Type locality*.—Lombreras, Salta Province, Argentina.

*Remarks*.—This species is closely related to *M. stenomorphus* and the pair is strikingly unlike any other species from South America. *M. monrosi* resembles *M. stenomorphus* in being of the same reddish-brown coloration and in having a similar convex, straight-sided prothorax with tiny teeth. Even the aedeagus is similar although heavier. Unlike *M. stenomorphus*, this is one of the largest of South American species of *Myochrous*, being as large as *M. armatus*. I take pleasure in naming it after its collector, Ing. Francisco Monrós, who has published excellent work on Chrysomelidae.

#### MYOCHROUS IMMUNDUS Erichson

#### PLATE 5, FIGURE 1

*Myochrous immundus* ERICHSON, Archiv für Naturg., vol. 13, p. 164, 1847.

About 6 mm. in length, elongate-oblong, black, shining with a bronzy luster beneath the long brown and white hairlike scales, intermingled with shorter, broader, and more appressed scales; prothorax as long as wide with rounded sides having three teeth marked by a tuft of hairs on each, very densely and coarsely punctate. Anterior tibiae without conspicuous inner tooth.

Head covered with pale pubescence, on occiput fine and not hiding the dense punctation below, in lower front becoming slightly coarser, between the antennal sockets lightly hairy, the usual occipital ridges if present at all very indistinct. Antennae and mouthparts reddish brown, antennae extending a little farther than usual, the third joint longer than fourth. Prothorax fully as long as wide, with rounded sides, not very convex, the three lateral teeth accentuated by a tuft of hairlike scales; a slight transverse depression anteriorly and a deeper one along the basal margin; punctures coarse and very dense, particularly toward the base; pubescence dense, the longer scales not closely appressed and somewhat concealing the shorter broader ones

below. Elytra nearly two and a half times as long as prothorax, moderately convex, with a slight transverse depression below the basal callosities; punctation not very coarse, well spaced, becoming finer in apical half and not entirely concealed by the rather long pubescence; as in the case of the prothorax, beneath the longer hairs a shorter thicker set of more closely appressed scales. Body beneath not very densely pubescent, with broader scales beneath the thorax and on the sides and finer, longer scales on the abdomen and legs; densely and moderately coarsely punctate. Legs deep reddish brown; anterior tibiae without the usual conspicuous tooth in the inner side, but a small tooth almost hidden in the long hairy vestiture and situated somewhat farther from the apex than usual and seen with difficulty; posterior femora toothed; claw joints unusually long. Length 5.8 to 6.4 mm.; width 2.8 to 3 mm.

*Type*.—In Berlin Museum?

*Type locality*.—Peru.

*Other locality*.—Chile.

*Remarks*.—Although nomenclatorially the type of the genus, *M. immundus* is morphologically one of the least typical species, being peculiar in having long hairlike scales in addition to the shorter broader scales beneath, and in having only a very inconspicuous tooth on the inside of the anterior tibiae which Erichson overlooked. It also has unusually long claw joints and long antennae.

#### MYOCHROUS EXPLANATUS Baly

##### PLATE 5, FIGURE 3

*Myochrous explanatus* BALY, Trans. Ent. Soc. London, ser. 3, pt. 4, p. 335, 1865.

From 8 to 9.5 mm. in length, oblong, deep reddish brown, shining beneath the short closely appressed yellowish scales; thorax not at all convex but flattened out toward the margin, with the margin varying from being almost arcuate, with three faint undulations, to having three well-developed lateral teeth; neither thorax nor elytra very densely or coarsely punctate.

Head covered with scales to the antennal sockets, beneath the scales surface rugosely and coarsely punctate, a median line down front ending in a broad shallow depression; the usual occipital ridge on either side. Antennae reddish brown, not extending much beyond the humeri, the outer joints not greatly enlarged. Prothorax considerably wider than long, not convex but flattened out on the sides with a depressed line along the base and a shallow depression on either side near the base; the margin varying from being almost arcuate or slightly undulate to distinctly 3-toothed, with a small tooth at apical and basal angles; surface beneath the fine, closely appressed yellow scales shining, finely and not densely punctate, the punctures becoming



coarser and denser toward the base, and interspersed with fine, shallow punctation (scale scars). Elytra not very convex, with small humeral prominences and two poorly defined costae in the basal part of each elytron, the striate punctation beneath the short, closely appressed yellowish scales unusually fine, leaving as wide an interspace between the punctures as the punctures themselves. Body beneath rather densely covered with scales, those on the prosternum much wider than elsewhere on the beetle, those on the abdomen and legs finer; first abdominal joint not coarsely punctate. Posterior femora not distinctly toothed, anterior tibiae with a blunt, rather inconspicuous tooth beneath the long hairs. Length 8 to 9.5 mm.; width 3.7 to 4.1 mm.

*Type*.—In British Museum of Natural History; a cotype examined.

*Type locality*.—Caracas, Venezuela.

*Other localities*.—VENEZUELA: Orinoco River, Mapire, Bolívar Province, Lake Laglaize: COLOMBIA; BOLIVIA.

*Remarks*.—This is the largest as well as flattest species of *Myochrous* yet to be found, and is distinguished by the flattened sides of the prothorax with a margin usually only undulate, yet occasionally with three well-developed teeth.

#### MYOCHROUS SALLEI Baly

##### PLATE 7, FIGURE 6

*Myochrous sallei* BALY, Trans. Ent. Soc. London, ser. 3, pt. 4, p. 335, 1865.

From 7 to 8 mm. in length, elongate, reddish brown, densely covered by closely appressed, short, white scales; thorax projecting over head and almost concealing it, fully as long as wide and strongly convex in front, inconspicuously 3-toothed.

Head covered by dense white scales down to antennal sockets, lower front less scaly, a median depressed line down front, upper part of head and occiput overhung by anterior part of thorax. Antennae longer than usual, extending down below the humeri, but of the usual proportions, bright reddish brown. Prothorax about as long wide, strongly convex in anterior part where it projects forward, with a thickened anterior margin almost concealing the occiput; depressed along the basal margin, especially over the scutellum; sides very little curved, nearly straight, with three tiny teeth; punctation dense, deep and coarse, becoming even coarser toward base and making the surface rugose with transverse ridging; some finer superficial punctures (scale scars). Elytra over twice as long as thorax, narrowly elongate, with small humeri, a slight trace of basal callosity and slight depression about scutellum; punctation coarse, contiguous, with transverse ridging in basal half, punctures becoming finer and more spaced toward the apex, scales dense, white, closely appressed and rather short and wide. Body beneath covered by white scales nearly as densely

as above except in the middle of the abdomen, first abdominal segment densely and finely punctate. Hind femora without distinct tooth, anterior tibiae with the usual inner tooth. Length 6.8 to 8.2 mm.; width 2.6 to 3.2 mm.

*Type*.—In British Museum of Natural History; a cotype examined.

*Type locality*.—Mexico.

*Other localities*.—MEXICO: Oaxaca, Playa Vicente, Sallé collection.

*Remarks*.—In its elongate shape, reddish brown coloration under the white scales, and convex thorax, *M. sallei* somewhat resembles *M. magnus* Schaeffer. It has white instead of yellow scales, is more slender, and has tinier teeth on the prothorax. The white scales make it one of the palest of the genus.

MYOCHROUS BRUNNEUS, new species

PLATE 7, FIGURE 5

About 5.5 mm. in length, elongate oblong, shining, deep reddish brown with short, closely appressed yellowish scales, thorax wider than long, convex, 3-dentate, and with coarse but not dense punctures; elytra with well-spaced striate punctation.

Head covered with short, closely appressed yellowish scales down to antennal sockets with the usual occipital ridge on each side and a median line down the front, lower front with a few short finer scales. Antennae deep reddish brown, of the usual proportions. Prothorax wider than long with three well-developed lateral teeth and the usual smaller apical and basal tooth; moderately convex, with a basal depression most marked over the scutellum; surface lustrous, coppery, with round, deep punctures not closely placed and becoming larger toward base. Elytra similarly lustrous beneath the short, yellowish scales, the striate punctures not closely set, becoming finer at apex; very little evidence of a basal callosity, and only a faint transverse depression. Body beneath shining under the short, sparse, fine scales, first abdominal segment with sparse coarse punctures. Hind femora bluntly toothed, anterior tibiae with the usual inner tooth. Length 5.3 mm.; width 2.4 mm.

*Type*.—A male, Museum of Comparative Zoology type No. 28124.

*Type locality*.—Amazon Valley, near Santarém, Brazil.

*Remarks*.—This is one of the reddish-brown species, distinguished by its sparse punctation, strongly convex thorax, and short, thickset aedeagus.

MYOCHROUS LONGIPES, new species

PLATE 1, FIGURE 2

About 6 mm. in length, oblong, deep reddish brown to shining bronze, densely covered by short, pale brown or grayish, closely appressed scales; thorax wider than long, rounded in the middle, 3-

toothed, with moderately dense, not coarse punctures; legs unusually long, reddish brown.

Head with a median line down occiput and the usual ridge on each side, surface somewhat rugose, covered by scales down to antennal sockets, lower front with fewer and finer scales. Antennae reddish brown, of the usual proportions. Prothorax wider than long, with three distinct lateral teeth, not very convex, but rounded over the middle, without depressions except along the basal margin; beneath the pale brown and grayish scales the surface moderately densely but not coarsely or rugosely punctate. Elytra two and a half times as long as thorax and considerably broader, with a distinct basal callosity on each side of the scutellum and behind this a slight transverse depression; striate punctures rather fine and not closely placed and becoming finer toward the apex, the short, coarse scales completely hiding the punctation and forming a pale mottled covering. Body beneath shining under the sparse pale scales, first abdominal segment rather sparsely punctate. Hind femora not distinctly toothed, anterior tibiae with a tooth on the inner side; tibiae unusually long. Length 5.3 to 6 mm.; width 2.5 to 2.7 mm.

*Type*.—A. male, U.S.N.M. No. 59029, collected in May 1925 by G. L. Harrington.

*Type locality*.—Chuani, Department of La Paz, Bolivia.

*Other localities*.—COLOMBIA: Cali (Rosenberg; in Bowditch collection); PERU: Chira; BOLIVIA: Huachi, Department of La Paz (June 1925; G. L. Harrington); BRAZIL: "Amazon," first Jacoby collection, Bowditch collection; Amazon River, Arary to Manáos; near Obidos (Holt, Blake, and Agostini); VENEZUELA (from culm of "guasduz"), Orinoco River near Mapiri, state of Bolívar (F. A. McClure).

*Remarks*.—This species is characterized by its short, even, scaly covering that completely hides the coppery or bronzy surface below, and by the rather long tibiae and the broad prothorax, which is rounded in the middle.

MYOCHROUS MAMORENSIS, new species

PLATE 8, FIGURE 5

About 5.5 mm. in length, oblong oval, reddish brown, mottled with broad, dense, yellow and brown scales; thorax densely but not very coarsely punctate, with 3-toothed margin, and anterior margin projected over the head; thorax about half as long as elytra and a little wider than long.

Head covered by scales concealing the rough, densely and obsoletely punctate surface beneath, a median depression becoming a median ridge in the lower frontal transverse depression; scales between antennal sockets short and fine and transversely placed. Antennae of the

usual proportions. Prothorax a little wider than long and about half as long as elytra, the anterior margin somewhat thickened and projecting over the head; sides 3-toothed, surface covered by dense, round punctures becoming coarser toward base and nearly concealed by the broad, curved, brown and white scales; depressed along basal margin, especially over the scutellum. Elytra with a transverse depression below basal callosities; densely covered by the broad, curved, brown and yellow scales, scales producing an irregularly mottled appearance and nearly concealing the striate punctation below; punctures well spaced and becoming finer toward apex with a tendency to ridging in basal part. Body beneath lightly covered by finer white scales, punctation on first abdominal segment not coarse or dense. Anterior tibiae with the usual toothing. Length 5.3 to 6 mm.; width 2.5 to 2.8 mm.

*Type and paratypes*.—Type and one paratype in Miguel Lillo Institute, Tucumán, Argentina, collected January 3, 1949, by Kuschel; one paratype, U.S.N.M. No. 59365; one paratype in Museum of Comparative Zoology.

*Type locality*.—Mamoré (? river), Trinidad, Bolivia.

*Remarks*.—This is one of the reddish-brown species, with a thickened anterior margin on the prothorax concealing the head. Only one other South American species has these two characteristics together, *M. bolivianus*, which is a stouter beetle having a quite different scale pattern.

#### MYOCHROUS PORTORICENSIS Blake

##### PLATE 7, FIGURE 1

*Myochrous portoricensis* BLAKE, Proc. Ent. Soc. Washington, vol. 49, p. 25, 1947.

From 5 to 6 mm. in length, oblong, shining dark brown to piceous black, beneath the dense pale scales. Prothorax covered with round, deep, but not at all confluent or ridged punctures; elytra with the striate punctures not so closely placed as in *cubensis* Blake.

Head covered by scales down to antennal sockets; a faintly depressed median line down front ending in a broad shallow depression; punctation deep, coarse, but not ridged, and lower front less densely punctate than in *cubensis*; the usual occipital ridges on either side. Prothorax a little wider than long with three well-developed lateral teeth and a slight depression along basal margin most marked over the scutellum; punctures not very coarse, round, deep, and so spaced as not to be confluent or ridged. Elytra with striate punctures well-spaced, not so close as in *cubensis*, coarse in basal part, becoming much finer toward apex. Body beneath with finer, sparser scales, punctures on first abdominal joint fine, not very dense. Hind femora inconspicuously toothed, anterior tibiae with the usual tooth. Length 5.2 to 6 mm.; width 2.4 to 3 mm.



*Type*—U. S. N. M. No. 57986, collected in February 1899 by August Busck.

*Type locality*.—Arroyo, Puerto Rico.

*Other localities*.—PUERTO RICO: Lake Guanica (A. Wetmore), in stomach of *Oxyechus*, May 26, 1912; May 31, 1938, same locality (P. J. Darlington).

*Remarks*.—The less coarsely punctate upper surface with no thoracic ridging distinguishes this from *cubensis*.

#### MYOCHROUS HISPANIOLAE Blake

##### PLATE 7, FIGURE 2

*Myochrous hispaniolae* BLAKE, Proc. Ent. Soc. Washington, vol. 49, p. 24, 1947.

From 5.5 to 6.8 mm. in length, elongate oblong, shining dark brown to piceous black, with pale scales, thorax with dense, deep, round punctures, not confluent or forming ridges or rugosities; elytra densely striate punctate.

Head covered with scales to antennal sockets, beneath the scales a very indefinite median line ending in the middle of the front in a shallow depression; coarse, dense, shallow, confluent punctures forming a network of irregular lines over the entire front, the usual occipital ridges on each side. Antennae yellowish or reddish brown, of the usual proportions. Prothorax not quite so long as broad, narrower than in *cubensis* or *portoricensis*, and with a depression along the basal margin most marked over the scutellum. Lateral margin with three well-developed teeth, disk not very convex and covered with dense, round punctures, not at all confluent or ridged and not very coarse. Elytra with faint basal callosities and a transverse depression below; punctation dense, not well spaced as in *portoricensis*, and with a slight tendency to transverse ridging in the depression near the base. Body beneath shining under the fine, sparse hairlike scales, first abdominal segment rather finely and not very densely punctate. Hind femora with a blunt tooth, anterior tibiae with the usual tooth. Length 5.4 to 6.8 mm.; width 2.6 to 3.2 mm.

*Type and paratypes*.—Type and four paratypes, Museum of Comparative Zoology, collected September 11, 1934, by P. J. Darlington; one paratype, U.S.N.M. No. 57985.

*Type locality*.—Swamps north of Dessalines, Haiti.

*Other localities*.—DOMINICAN REPUBLIC: Montecristi, June 1938, Sánchez, July 1938, Puerto Plata, August 20 to September 2, 1938 (all collected by P. J. Darlington): HAITI, Etang Lachaux, 1934; Miragoâne, October 30 to November 2, 1934; Emery (1,000 feet altitude) September 11, 1934, Trou Caiman, September 4, 1934 (all collected by P. J. Darlington).

*Remarks*.—This species appears to be a little more slender than *M. cubensis* and with a narrower prothorax. The sculpture of the head

differs from both *cubensis* and *portoricensis* in being so densely punctate as to present a network of lines over the occiput. The thorax also is very densely and rather finely punctate without any ridgings or rugosities.

MYOCHROUS JAMAICENSIS Blake

PLATE 7, FIGURE 3

*Myochrous jamaicensis* BLAKE, Proc. Ent. Soc. Washington, vol. 49, p. 26, 1947.

About 6 mm. in length, elongate oblong, shining piceous black, covered by pale scales; thorax densely punctate, with the punctures somewhat elongate and in short lines, giving the surface a slightly ridged effect, but not so deeply ridged as in *cubensis*.

Head covered with scales down to the antennal sockets, beneath the scales a poorly defined median line down front and dense coarse punctures making surface rugose, lower front finely and sparsely punctate; the usual occipital ridges on each side. Antennae reddish brown, of the usual proportions. Prothorax wider than long, moderately convex, with three well-developed lateral teeth and the usual apical and basal teeth; a depressed line along the basal margin most pronounced over the scutellum; surface densely and rugosely punctate, the somewhat elongate punctures occurring in short lines, often confluent, but not forming such deep ridges as in *cubensis*. Elytra with a slight basal callosity and faint transverse depression below; the rows of punctures closely placed and not very coarse or with transverse ridgings. Body beneath with the first abdominal segment rather finely punctate. Hind femora bluntly toothed, anterior tibiae with the usual tooth. Length 6 mm.; width 2.7 mm.

*Type*.—A female, U.S.N.M. No. 57997.

*Type locality*.—Manchioneal, Jamaica, collected January 30, 1937, by E. A. Chapin and R. E. Blackwelder.

*Remarks*.—*M. jamaicensis* appears to be halfway between the Cuban and the Hispaniolan species. Although there is a tendency toward ridging on the thorax, the ridges are not so dense or so deeply cut and the punctation is not so close as in *cubensis*. The thorax is not so heavy as in *cubensis*, in this respect resembling that of *hispaniolae*.

MYOCHROUS CUBENSIS Blake

PLATE 7, FIGURE 4

*Myochrous cubensis* BLAKE, Proc. Ent. Soc. Washington, vol. 49, p. 23, 1947.

From 4.5 to 6 mm. in length, elongate oblong, shining dark brown to piceous black, beneath the short, pale, not closely appressed scales; prothorax coarsely and rugosely punctate, with the elongate punctures often confluent and forming ridges; elytra moderately finely and densely striate punctate.

Head covered by scales to antennal sockets, with a faint, depressed, median line down front; punctation beneath the scales coarse, sometimes confluent, dense, rugose, the usual occipital ridges on each side; lower front densely but not so coarsely punctate, with a short fine scale from each puncture. Antennae reddish or yellowish brown, of the usual proportions. Prothorax large, a little broader than long, almost as broad as elytra; evenly convex with a slight median basal depression over the scutellum; sides with three well-developed teeth as well as a basal and an apical tooth; punctation coarse, deep, elongate, usually in confluent longitudinal lines. Elytra without any distinct basal callosities, a slight lateral depression below the humerus; punctation not entirely hidden by the short, pale, somewhat curved scales; punctures comparatively rather fine and dense without transverse ridging. Body beneath lustrous under the short white hairlike scales, first abdominal segment rather densely but not coarsely punctate. Hind femora bluntly toothed, anterior tibiae with the usual inner tooth. Length 4.5 to 6.1 mm.; width 2 to 2.8 mm.

*Type and paratypes.*—Type and nine paratypes, U.S.N.M. No. 57984, collected by E. A. Schwarz; one paratype in the Museum of Comparative Zoology.

*Type locality.*—Cayamas, Cuba.

*Other localities.*—CUBA: Agramonte, Camagüey Province, July 2, 1934 (J. Acuña); Baraguá, May 16, 1927 (L. Scaramuzza, taken on *Capsicum* sp. on May 26, 1927, by the same collector on sugarcane, on June 12, 1925, by Lomanitz on sugarcane); Cape Covadonga, Zapata, "S. W.," September 16, 1936 (Davenport); Cape Jareno (H. K. Plank, feeding on sugarcane); Cape Velasco, November 4, 1930; Chaparra, July 10, 1915 (L. Scaramuzza, on sugarcane); Habana (Baker and Barbour); San Antonio de los Baños (José H. Pazos); Santiago de las Vegas, August 30, 1930 (S. C. Bruner; on May 20, 1923, by A. Otero).

*Remarks.*—The roughly sculptured prothorax distinguishes this from the other West Indian species. The aedeagi of the species from Cuba, Puerto Rico, Dominican Republic, and probably Jamaica (no male seen) are very much alike, but the beetles themselves consistently show minor differences. As in the case of the genus *Disonycha*, certain groups of species in *Myochrous* such as the present one are still not very far developed in their specific differences.

In an earlier paper on the species of *Myochrous* from the West Indies I discussed *Myochrous dubius* (Fabricius), which was described from a specimen collected in "America meridionali." The description does not fit very well any species of *Myochrous*, and it seems best not to attempt to apply this name at present.

## MYOCHROUS SPINIPES, new species

## PLATE 8, FIGURE 2

About 4 mm. in length, deep brown to picaceous beneath the curved not closely appressed scales; pronotum dull, alutaceous, as long as wide, concealing the head, sides minutely 3-toothed; elytra shining; front tibiae with little trace of toothing before the apex but strongly spurred at apex; middle tibiae with a conspicuous spur before the apex and hind tibiae in male strongly spurred before apex.

Head broadly rounded over occiput with a faint trace of median line in some specimens; no trace of occipital ridges, surface alutaceous, punctate, covered by scales to antennal bases, space between antennal sockets shining under the transversely placed sparse white scales; labrum yellowish brown. Antennae pale and of the usual proportions. Prothorax projecting over the head and concealing it, fully as long as wide, rather flat with a depression behind the narrowed and somewhat elevated anterior portion; sides minutely 3-toothed with a strong toothing behind the eyes at apical angle and a small tooth at basal angle; surface dull, alutaceous, with moderately dense round punctures; scales not appressed but standing up in little curved loops all over the surface, not very dense. Elytra shining beneath the brown and white rather coarse and curved scales, the scales forming an irregular color pattern; striate punctures dense and moderately coarse, in some specimens a slight costa down the middle; very little basal elevation, a small transverse depression on the side below the humerus. Body beneath shining through the finer, pale scales; breast and first abdominal segment densely and coarsely punctate; anterior tibiae with a faint trace of an inner tooth near the apex and strong spurs at the apex; middle tibiae in both sexes toothed, hind tibiae in males sharply spurred before the apex. Length 3.5 to 4.5 mm.; width 1.5 to 2 mm.

*Type and paratypes.*—Type male and 28 paratypes, U.S.N.M. No. 59302, collected on rice June 8, 1949, by L. A. Salas; 2 paratypes in Museum of Comparative Zoology.

*Type locality.*—VENEZUELA: Acarigua, Portuguesa, collected on rice June 8, 1949, by L. A. Salas.

*Remarks.*—The spurs on the middle and hind tibiae shortly before the apex distinguish this species from all others in the genus. The anterior tibiae lack the usually well-developed spur before the apex. This peculiarity together with the small size and the long prothorax make the species easily recognized. A good series of beetles was sent to the U. S. Department of Agriculture from Venezuela with the note that they were damaging growing rice.



## MYOCHROUS CALCARIFERUS, new species

## PLATE 8, FIGURE 1

Between 4 and 5 mm. in length, elongate oblong, black, with the thorax approximately as long as wide, concealing head, and elytra more than twice as long as thorax; scales on thorax and elytra wide and forming a distinct brown and white pattern; punctation of thorax dense; front tibiae with only a faint trace of toothing before the apex, middle and probably also the hind tibiae in male (males not seen), with a distinct spur before the apex.

Head concealed from above by overhung anterior margin of prothorax, occiput with trace of ridging on either side, not entirely covered by scales but showing the alutaceous surface beneath; scales broad, curved, and not flatly appressed, between antennal sockets finer and transversely placed; labrum and antennae reddish brown. Antennal joints of the usual proportions. Prothorax approximately as long as wide with a convex projected anterior margin; a faint transverse depression behind eyes; sides 3-toothed, surface alutaceous with dense and not coarse, round punctures not entirely concealed by the broad brown and white curved scales, scales forming a pattern. Elytra more than twice as long as thorax, shining bronzy black beneath the broad brown and white scales; striate punctures coarse but not ridged, basal callosities not pronounced, a faint depression below; scales forming a pattern with the humeri and sides more or less white and a white spot near apex. Body beneath finely alutaceous but moderately shining, breast and first abdominal segment not coarsely punctate, with scattered fine white scales; front tibiae with a very obscure tooth before apex on the inner side and a more marked one at apex on outer edge; middle tibiae of female with a distinct spur before the apex, probably also one of the hind tibiae of male although no male examined. Length 4.3 to 4.8 mm.; width 1.8 to 2 mm.

*Type and paratypes.*—Type female in the Miguel Lillo Institute, Tucumán, Argentina, collected January 3, 1949, by Kuschel; one paratype, U.S.N.M. No. 59364; one paratype in the Museum of Comparative Zoology.

*Type locality.*—Almacea, Trinidad, Bolivia.

*Remarks.*—This species is very close to *M. spinipes* from Venezuela, having a similar structure, particularly in the spurs on the tibiae. This character is found up to this time in these two species only. The chief difference between the two species appears to be in the proportions of the body, in *M. calcariferus* the elytra are over twice as long as the thorax in the three females examined although the elytra are scarcely any wider than in *M. spinipes*. There are also slight differences in the color, the Bolivian species being black, the Venezuelan more frequently brownish, and in the punctation on the first segment of the abdomen, which in the Venezuelan species is coarser and denser.

## DISCUSSION OF MYOCHROUS ALBOVILLOSUS JACOBY

## PLATE 8, FIGURE 4

*Pachnephorus tessellatus* DUFTSCHMID, Fauna Austriaca, vol. 3, p. 217, 1825.  
*Myochrous albovillosus* JACOBY, Biologia Centrali-Americana, Coleoptera, vol. 6, pt. 1, p. 176, 1882.

*Myochrous albovillosus*, described by Jacoby from "Mexico," is really a species of *Pachnephorus* that occurs about the Mediterranean. There are two cotypes, one in the British Museum (in the Baly collection, collected by Pilate) and the other in the Museum of Comparative Zoology (in the Bowditch collection from Jacoby's collection). I compared a specimen of *Pachnephorus tessellatus* Duftschmid with the cotype in the Museum of Comparative Zoology and found them indistinguishable. The short antennae with the greatly thickened distal joints, the thorax without toothings, the abdomen with the very long first segment, the shallow emargination at the apex of the middle and hind tibiae, and the broad, bifid scales all place this species in *Pachnephorus* rather than in *Myochrous*. The detailed description of the Museum of Comparative Zoology cotype is as follows:

About 3.7 mm. in length, oblong oval, shining dark brown beneath with the dense, closely appressed, pale brown and white scales, the scales short, broad, bifid. Antennae barely reaching the base of the prothorax, the five distal joints much enlarged, and as wide as long. Prothorax cylindrical, as long as broad, with a small apical and basal tooth but no signs of lateral toothings, sides arcuate; disk without depressions except along the basal margin, smoothly covered by broad, pale scales, the scales in the center a little darker; punctation beneath apparently rather dense and fine. Elytra broader than prothorax, tapering at apex, rather convex, with prominent humeri, and covered by broad scales that form a pattern, white along the base and on humeri, and down the middle of each elytron two or more white spots, and another along the side; rows of striate punctures not contingent but well-spaced, and the punctures round. Body beneath more densely clad with narrower and longer scales, particularly along the sides of the abdomen, down the middle of the abdomen and on the upper underbody less scaly; first abdominal segment nearly half the length of abdomen; legs less densely scaly, not toothed; middle and hind tibiae with an emargination at apex; anterior tibiae without toothings.

It seems likely that some mistake in locality labels may have been made, as none of the species of *Pachnephorus* is known to occur in the Western Hemisphere. *Pachnephorus tessellatus* is reported in Junk's Catalogue as occurring in middle and southern Europe, central Asia, and Mongolia.



1. *Myochrous denticollis* (Say)



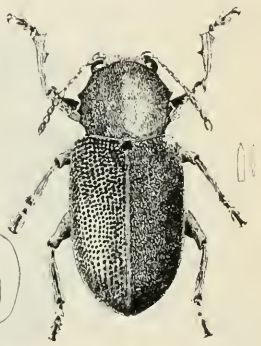
3. *M. rufus*



2. *M. longipes*



4. *M. melancholicus* Juc



5. *M. austrinus*



7. *M. carinatus* Juc



6. *M. platylongus*



8. *M. geniv*

SPECIES OF MYOCHROUS





1. *M. squamosus* Lec.



2. *M. severini*



3. *M. intermedius*



4. *M. magnus* Schaeff.



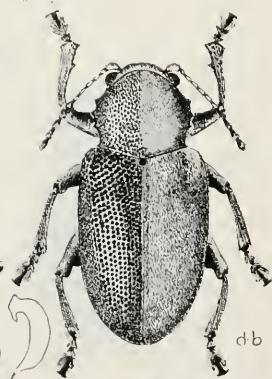
5. *M. pauxillus* Schaeff.



6. *M. floridanus* Schaeff.



7. *M. floridanus* subsp. *texanus*



8. *M. tibialis* Jac.





1. *M. runcilla*



2. *M. latisetiger*



3. *M. novallus* Johnson



4. *M. whitei*



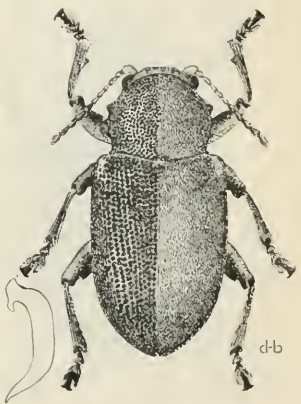
5. *M. longulus* Lec.



6. *M. coenus*

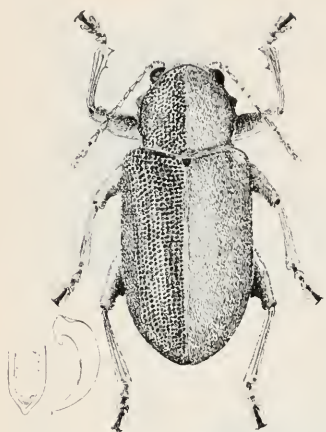


7. *M. barbadensis* Blake



8. *M. femoralis* Jac.

SPECIES OF MYOCHROUS



1. *M. normalis*



2. *M. rhabdatus*



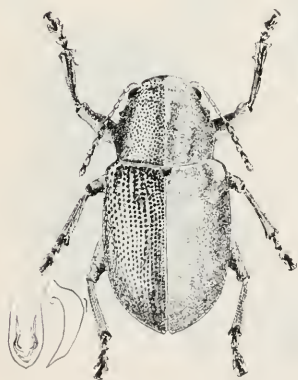
3. *M. elachius*



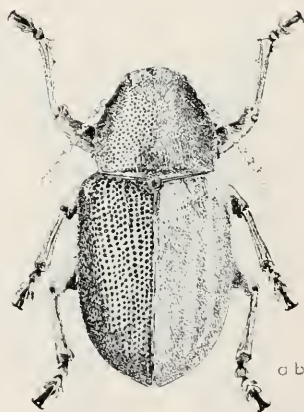
4. *M. paulus*



5. *M. nanus*

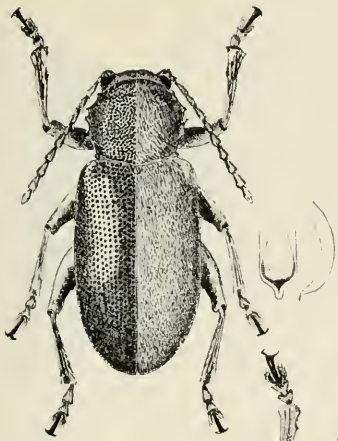


6. *M. bolivianus*



7. *M. chacoensis*

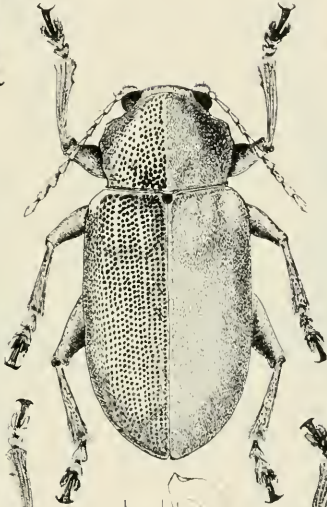
SPECIES OF MYOCHROUS



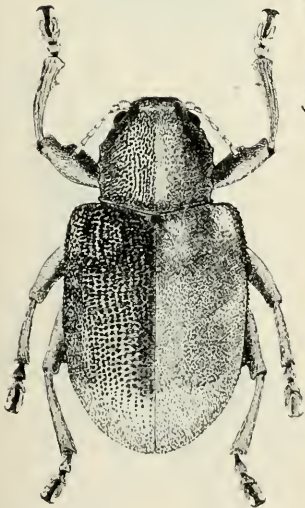
1. *Mimundus Ericsoni*



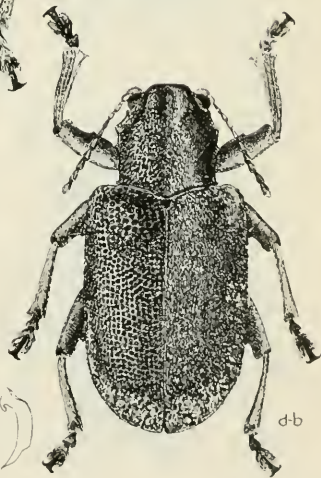
2. *Mimundus marginatus*



3. *Mimundus explanatus* Baly



4. *M. leucurus*



5. *M. curculionoides* Lct.

SPECIES OF MYOCHROUS

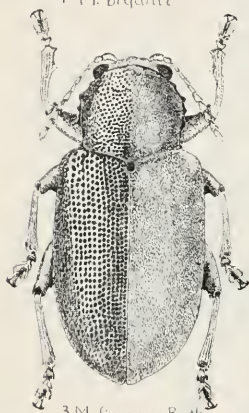




1 *M. biyanti*



2 *M. saporayensi*



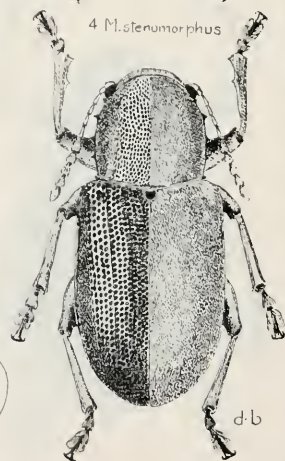
3 *M. fiqueroae* Breth



4 *M. stenomorphus*



5 *M. armatus* Baly



6 *M. monrosi*

SPECIES OF MYOCHROUS





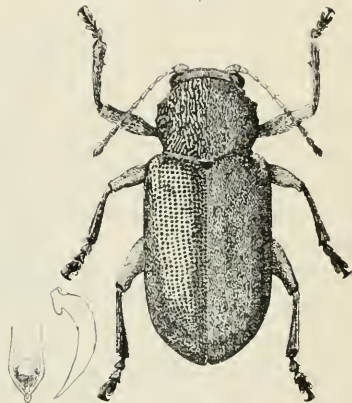
1. *M. portoricensis* Blake



2. *M. hispaniolae* Blake



3. *M. jamaicensis* Blake



4. *M. cubensis* Blake



5. *M. brunneus*



6. *M. sallei* Buly

SPECIES OF MYOCHROUS



1 *Mecalcariferus*



2 *M. spangui*



3 *M. darlingtoni*



4 *Pachnephorus tessellatus* Duf.  
(*M. albopillosus* Jac.)



5 *M. mainvicensis*

SPECIES OF MYOCHROUS



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## THE OCEANIC CRABS OF THE GENERA *PLANES* AND *PACHYGRAPSUS*

By FENNER A. CHACE, Jr.

ON September 17, 1492, at latitude approximately 28° N. and longitude 37° W., Columbus and his crew, during their first voyage to the New World, "saw much more weed appearing, like herbs from rivers, in which they found a live crab, which the Admiral kept. He says that these crabs are certain signs of land . . ." (Markham, 1893, p. 25). This is possibly the first recorded reference to oceanic crabs. Whether it refers to *Planes* or to the larger swimming crab, *Portunus* (*Portunus*) *sayi* (Gibbes), which is seldom found this far to the east, may be open to question, but the smaller and commoner *Planes* is frequently called Columbus's crab after this item in the discoverer's diary.

Although these crabs must have been a source of wonder to mariners on the high seas in the past as they are today, the first adequate description of them did not appear until more than two centuries after Columbus's voyage when Sloane (1725, p. 270, pl. 245, fig. 1) recorded specimens from seaweed north of Jamaica. A short time later Linnaeus (1747, p. 137, pl. 1, figs. 1, *a-b*) described a similar form, which he had received from a Göteborg druggist and which was reputed to have come from Canton. This specimen, which Linnaeus named *Cancer cantonensis*, may be the first record of the Pacific *Planes cyaneus*. The Atlantic species, found "in Palgi *Fuco natante*," was finally described under the name *Cancer minutus* by Linnaeus in the tenth edition of "Systema Naturae" (1758, p. 625). Bowdich (1825, p. 15, pl. 12, figs. 2, *a-b*) briefly described and figured a crab found on a floating log northeast of Madeira as *Planes clypeatus*.

There is little doubt that Bowdich's species is conspecific with that described earlier by Linnaeus, and the combination *Planes minutus* is now generally accepted for the Atlantic species, despite repeated attempts to substitute *Nautilograpsus* H. Milne-Edwards (1837, p. 90) for *Planes*.

As specimens of *Planes* trickled into collections from all parts of the world in the early part of the nineteenth century, there was a natural tendency to propose new names for varieties from widely separated localities. A dozen different specific names were applied to these crabs between 1775 and 1858. Thereafter the acquisition of larger series of specimens served to illustrate the variability of these forms. All the post-Linnaean names were subsequently synonymized with *P. minutus*, and no additional ones were proposed except *Planes marinus* Rathbun (1914, p. 120). The validity of even that species became more and more questionable as time passed without additional specimens being found.

It was the rediscovery of that form that led to the present study. In December 1947 four crabs were found among marine organisms attached to a derelict Japanese mine that drifted ashore at Lincoln Beach, Oreg. These proved to be the species described by Dr. Rathbun and not reliably reported since her record of the type series taken in the Pacific Ocean west of Baja California. Search of the uncataloged collections in the U. S. National Museum revealed two more specimens of this species, these from the Hawaiian Islands. A subsequent query addressed to Dr. C. H. Edmondson at the Bernicé P. Bishop Museum in Honolulu led to the discovery of several lots in that institution. A comparison of this form with specimens of *Planes minutus* indicates that the two are generically as well as specifically distinct and that there are at least two species of *Planes* s. s., one found in the Atlantic and one in the Pacific.

No attempt is made here to delimit these oceanic forms completely either taxonomically or geographically. Additional material from critical areas and "hosts" must be studied before this can be done. It has been my aim to bring together as many of the scattered references to these species as possible in the hope that workers elsewhere may be encouraged to re-examine material at their disposal or to collect specimens from other areas with a view to verifying or modifying the conclusions outlined here. A species believed to be identical and common in all the warmer seas of the world soon loses its interest; collectors fail to take the trouble to preserve specimens when they are found, and museum workers neglect to examine critically those that are received. If this trend can be reversed as far as these crabs are concerned, it is not unlikely that interesting findings related to speciation and zoogeography may be forthcoming.



Practically none of the references to *Planes* in the literature are determinable to species except on a geographic basis. The synonymies listed below have been compiled more or less arbitrarily, all the records from the Atlantic and Indian Oceans being credited to *P. minutus* and those from the Pacific to *P. cyaneus*. It is very possible that this disposition, particularly as it concerns the Indian Ocean forms, may have to be altered when additional data are obtained.

This opportunity is taken to thank those persons whose gracious assistance has made this study possible: Dr. Louis W. Hutchins, of the Woods Hole Oceanographic Institution, for furnishing the specimens of *Pachygrapsus marinus* which prompted the survey; John C. Armstrong, of the American Museum of Natural History, Dr. Elisabeth Deichmann, of the Museum of Comparative Zoology, and Dr. C. H. Edmondson, of the Bernice P. Bishop Museum, for providing loans of critical specimens; Mr. and Mrs. Boonyong Nikrodhananda, of Bangkok, Siam, for making a cursory survey of drifting objects that might harbor crabs, during an extended transpacific voyage; and finally my colleagues in the U. S. National Museum for their assistance and encouragement during the preparation of this paper.

#### MORPHOLOGICAL CHARACTERS

The species of *Planes* are extremely variable. This fact has led to the general abandonment of all previous attempts to recognize more than one species in the genus. When Stimpson (1860, p. 231) made the statement that "we are unable to distinguish the specimens [from Baja California] from those collected from Gulfweed in the North Atlantic," the conspecific status of the various forms of *Planes* seemed to be finally established, and few subsequent attempts to delimit other than the genotype were attempted; even the validity of the very distinct form described as *Planes marinus* by Dr. Rathbun has been questioned.

The present study indicates, however, that at least some of the variable characters involved show a discontinuity between the Atlantic and Pacific forms of the genus (table 1). Probably the most useful of these characters is based on the relative lengths of the walking legs. In *P. cyaneus* from the Pacific the legs are noticeably shorter than in *P. minutus* from the Atlantic and Indian Oceans. This difference in relative leg length is not so apparent in figure 1 as it would be if specimens of *P. minutus* and *P. cyaneus* of similar carapace lengths had been available for figuring. The discrepancy is more obvious in figure 2, *d*, *e*, where legs from specimens of similar size are compared. It was found that the simplest way to demonstrate this difference is to compare the combined lengths of the three distal segments of the second walking leg with the carapace length (figs. 6, 7). The slight overlap in this character between the Atlantic and Pacific forms may

be a real one, or it may be a result of contraction or expansion of the leg in preservative or of the possibility that regenerating and not fully developed legs of *P. minutus* have been included among the material measured.

TABLE 1.—*Synopsis of characters*

Characters	<i>Planes minutus</i>	<i>Planes cyaneus</i>	<i>Pachygrapsus marinus</i>
<b>CARAPACE:</b>			
Length.....	3.7 to 19 mm.....	5 to 25 mm.....	5 to 19 mm.
Proportions (see fig. 4).....	About as wide as long, length to width as 1:0.91 to 1.12.	Usually slightly longer than wide, length to width as 1:0.86 to 1.06.	Distinctly wider than long, length to width as 1:1.07 to 1.16.
Shape (see fig. 3).....	Subquadrate in young (3.7-6 mm.); trapezoidal in medium sized (6-12 mm.); laterally convex in old specimens (12-19 mm.).	Laterally convex at all ages.	Subquadrate at all ages.
Surface of branchial regions.	Faintly striate laterally..	Faintly striate laterally....	Distinctly striate laterally.
<b>MALE ABDOMEN:</b>			
Shape (see fig. 2, <i>g-i</i> )..	Rather broadly triangular, length of four distal segments about 1.24 times basal width of fourth segment.	Narrowed beyond third segment, length of four distal segments about 1.26 times basal width of fourth segment.	Broadly triangular, length of 4 distal segments about 1.08 times basal width of fourth segment.
Terminal segment....	Rather narrowly triangular, about as long as basal width.	Laterally convex, about 0.9 as long as basal width.	Broadly triangular, about 0.9 as long as basal width.
<b>CHELAE:</b>			
Fixed finger (see fig. 2, <i>a-c</i> )..	Bent sharply downward, especially in males.	Bent sharply downward, especially in males.	Not noticeably bent downward.
Surface of hand.....	With prominent sharp granules near lower margin.	With prominent sharp granules near lower margin.	Few inconspicuous granules near lower margin.
<b>WALKING LEGS:</b>			
Form (see fig. 2, <i>d-f</i> )..	Long, slender, and flattened.	Short, slender, and flattened.	Rather short, stout, and not noticeably flattened.
Hairs on upper anterior margin of propodus of three anterior pairs.	Forming a natatory fringe.	Forming a natatory fringe..	Stout and forming a dense growth without a natatory fringe.
Proportion of length of three distal segments of second pair to carapace length (see fig. 6).	0.83 to 1.07.....	0.68 to 0.89.....	0.77 to 0.99.

*Planes cyaneus* appears to be a somewhat larger form than *P. minutus*. The smallest specimens of the latter examined measure 3.7 mm. in carapace length, and the largest 19 mm. Comparable measurements for *P. cyaneus* are 5 and 25 mm. The mean carapace width is usually about the same as the mean length in *P. minutus*, whereas it is somewhat less in *P. cyaneus* (figs. 4, 5); this character is demonstrable only in long series of specimens, however, and is of far less importance than the length of the walking legs.

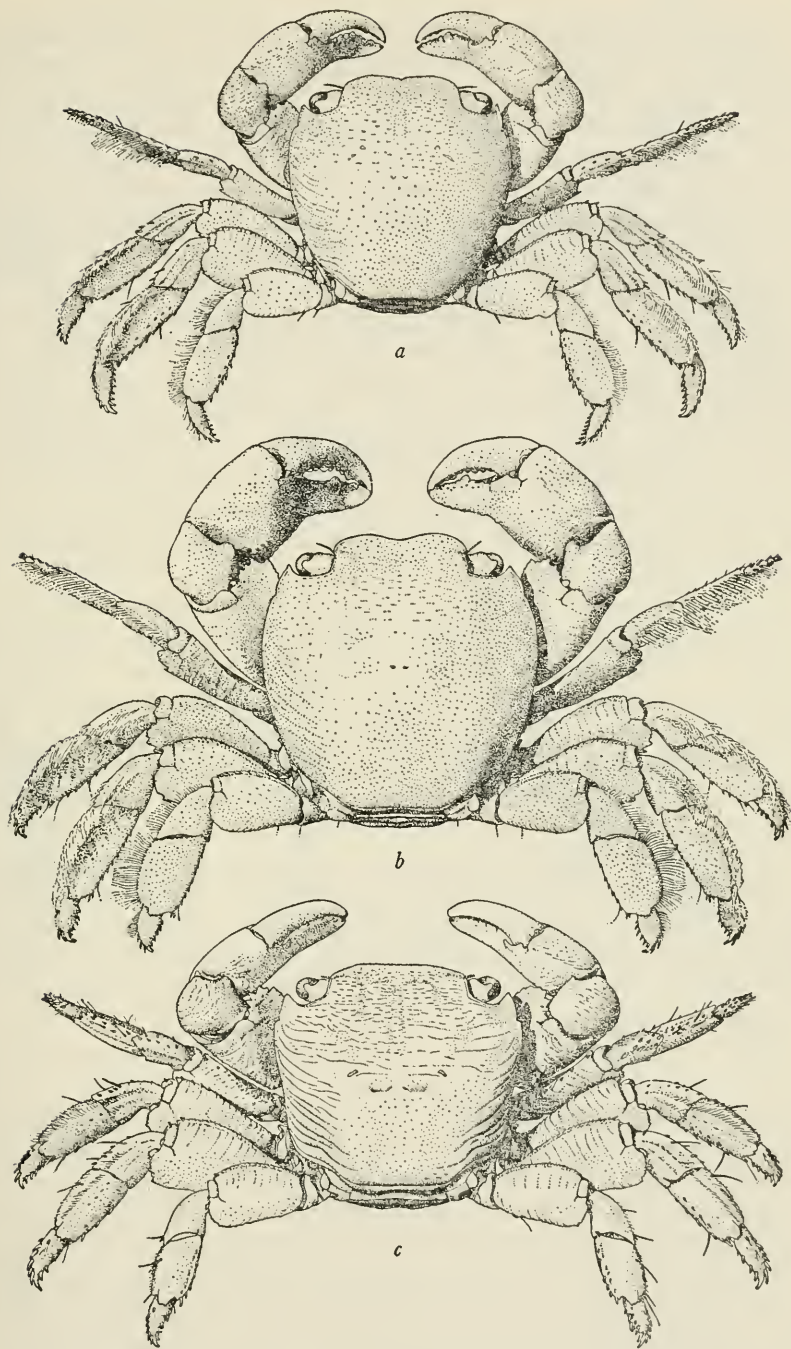


FIGURE 1.—*a*, *Planes minutus*, male (U. S. N. M. No. 4558), carapace 13.4 mm. long  
*b*, *Planes cyaneus*, male (U.S.N.M. No. 20695), carapace 16.6 mm. long; *c*, *Pachygrapsus marinus*, male paratype (U.S.N.M. No. 22833), carapace 13.8 mm. long.



The shape of the carapace is much more variable in *P. minutus* than in *P. cyaneus*, but much of the variation in the former species is correlated with size (fig. 3). In the smallest specimens of *P. minutus* examined (carapace length 3.8 to 4.5 mm.) the carapace is nearly square. At a carapace length from about 4.5 to 5.5 mm., the carapace becomes more or less convex laterally, as in *P. cyaneus*; this stage is smaller than any specimens of the Pacific species examined, however, and so there is little difficulty in separating the young stages of the two species. Following this stage the carapace becomes narrowed posteriorly and assumes a more or less trapezoidal shape; this shape persists in most specimens up to those with carapace lengths of 11 or 12 mm. and is the form commonly found living on *Sargassum*. As the crab becomes larger than this, the carapace becomes more convex laterally and less narrowed posteriorly and thus closely resembles *P. cyaneus* once more. No such polymorphism has been noted in the latter species; in that form the carapace is laterally convex at all sizes. The front is often more deeply excavate in *P. cyaneus* than in *P. minutus*, but this character is extremely variable.

The shape of the male abdomen, one of the characters upon which Dana based *P. cyaneus*, is usually distinctive in the two species (fig. 2, *g, h*). The lateral margins are less sharply convergent from the third to the sixth segment in *P. cyaneus* than in *P. minutus*, thereby giving the abdomen of the former a narrower appearance. The terminal segment is in the form of a nearly equilateral triangle in *P. minutus*, whereas its lateral margins are noticeably convex in *P. cyaneus*.

No consistent differences in the form of the male abdominal appendages could be found. The apparent differences indicated in figure 2, *j-r*, are probably no greater than may be found by examining first pleopods from several individuals of the same species. Even the form of that appendage in *Pachygrapsus marinus* is of questionable value as a taxonomic character.

From the material available the two forms of *Planes* appear to be sufficiently well marked to be recognized as distinct species. Additional material, particularly from the South Atlantic, Indian, and western Pacific regions should be examined, however; if intermediate forms are found in those areas it may be advisable to reduce *P. cyaneus* to subspecific status. As mentioned in the remarks on relative growth (p. 73), there is some indication that two forms may be represented in the Atlantic: a small trapezoidal one living on floating weed and a larger one, approaching *P. cyaneus* in form, found on turtles, floating logs, and other flotsam. Additional specimens of various sizes from the latter habitat should be examined to determine whether this form is distinct or not.



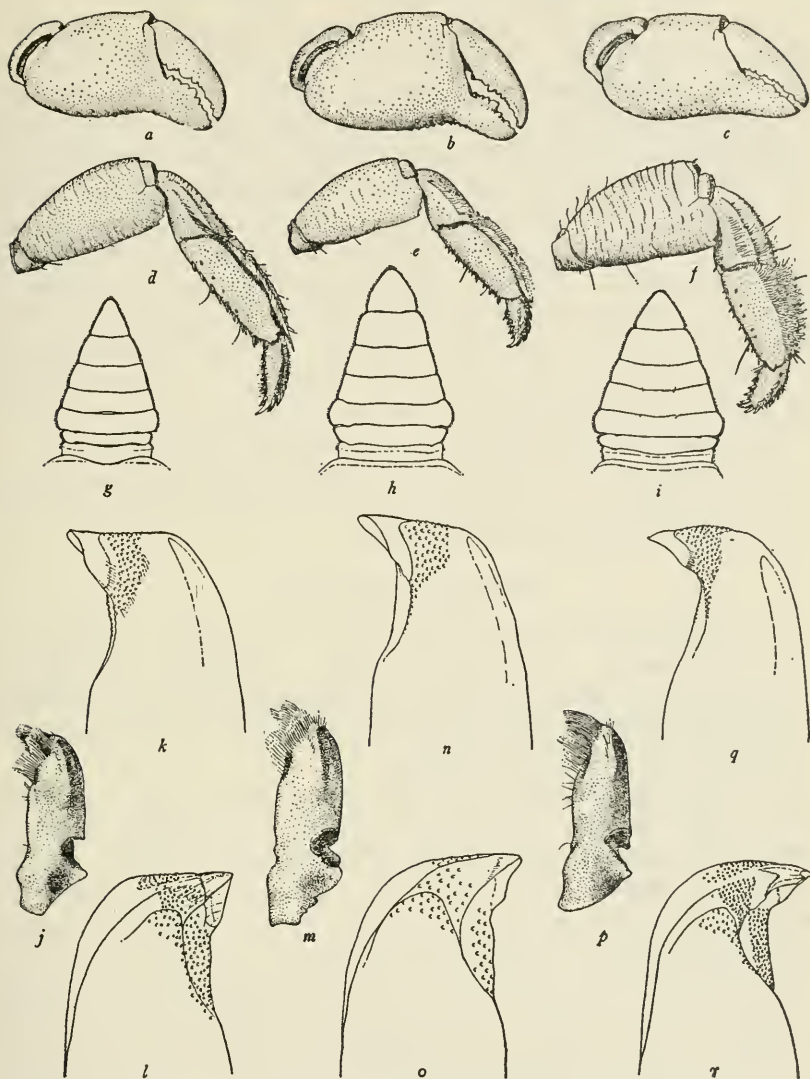


FIGURE 2.—a, Right chela of *Planes minutus*, male (U.S.N.M. No. 4558), carapace 13.4 mm. long; b, right chela of *Planes cyaneus*, male (U.S.N.M. No. 17449), carapace 15.9 mm. long; c, right chela of *Pachygrapsus marinus*, male paratype (U.S.N.M. No. 22833), carapace 13.8 mm. long; d, right second walking leg of *Planes minutus*, male (U.S.N.M. No. 17712), carapace 15.5 mm. long; e, right second walking leg of *Planes cyaneus*, male (U.S.N.M. No. 20700), carapace 15.3 mm. long; f, right second walking leg of *Pachygrapsus marinus*, male (U.S.N.M. No. 88069), carapace 15.1 mm. long; g, Abdomen of *Planes minutus*, male (U.S.N.M. No. 4558), carapace 13.4 mm. long; h, abdomen of *Planes cyaneus*, male (U.S.N.M. No. 20695), carapace 16.6 mm. long; i, abdomen of *Pachygrapsus marinus*, male paratype (U.S.N.M. No. 22833), carapace 13.8 mm. long; j, first right pleopod, mesiocaudal view, of *Planes minutus*, male (U.S.N.M. No. 4558), carapace 13.4 mm. long; k, denuded tip of first right pleopod, mesiocaudal view, of *Planes minutus*, male (U.S.N.M. No. 17712), carapace 15.5 mm. long; l, same, laterocephalic view; m, first right pleopod, mesiocaudal view of *Planes cyaneus*, male (U.S.N.M. No. 20695), carapace 16.6 mm. long; n, denuded tip of same, mesiocaudal view; o, same, laterocephalic view; p, first right pleopod, mesiocaudal view, of *Pachygrapsus marinus*, male paratype (U.S.N.M. No. 22833), carapace 13.8 mm. long; q, denuded tip of same, mesiocaudal view; r, same, laterocephalic view.

The species that Dr. Rathbun (1914, p. 120, pl. 3) described as *Planes marinus* differs so markedly from the other species of *Planes* in its wider, subquadrate, and distinctly striate carapace, differently formed chelae, and the absence of a natatory fringe of hairs on the propodi of the first three pairs of walking legs (table 1) that it is here transferred to the genus *Pachygrapsus*. Except for its much smaller size, this species is very similar to *Pachygrapsus crassipes* Randall from the Pacific coast of North America and the shores of the Japanese islands and Korea. The only obvious character, apart from size, in which *P. crassipes* and *P. marinus* differ is the absence of lateral lobules on the front in the latter species. Unless this species is removed from *Planes* on the basis of the characters mentioned above, the distinction between *Planes* and *Pachygrapsus* would cease to exist and *Pachygrapsus* would have to be synonymized with *Planes*.

Examination of one of the two specimens recorded as *Planes marinus* by Ward (1939, p. 14) indicates that these specimens, like the others mentioned in that paper, are *P. cyaneus*.

#### RELATIVE GROWTH

The examination and measurement of the large number of specimens of *Planes minutus* used in this study suggest a problem involving the relative growth of that species which might prove to be of considerable interest if it could be followed up with the analysis of more material from drift logs, turtles, and so forth.

The carapace length-width relationship remains fairly constant, with a slight tendency toward narrowing, from the smallest immature specimens examined to a carapace length of about 11 mm. At this stage the carapace seems to become somewhat narrower rather abruptly and continues to become narrower at a slightly more rapid rate than during the younger stages (figs. 4, 5). A similar, but even more striking, trend is noticed in the relative shortening of the walking legs (figs. 6, 7). In other words, there is a tendency for the larger specimens of *P. minutus* to approach the laterally convex, narrow form (fig. 3) and short walking legs of *P. cyaneus*. These similarities are so striking that I was at first led toward the belief that the larger Atlantic specimens are conspecific with those from the Pacific. It will be seen from figures 4 through 7, however, that the mean width of the carapace in the Atlantic form never becomes quite as narrow relative to the length as in the Pacific form, and the legs are always distinctly longer in the Atlantic species (tables 2, 3).

Although the material at hand has not been sufficiently well documented to verify the hypothesis, it is not improbable that most of the specimens of *P. minutus* having a carapace length of more than about 11 mm. are not found on *Sargassum*, but on flotsam and turtles. The

TABLE 2.—Mean values of carapace proportions

<i>Planes minutus</i>			<i>Planes cyaneus</i>			<i>Pachygrapsus marinus</i>		
Number of specimens	Mean carapace length	Mean carapace width	Number of specimens	Mean carapace length	Mean carapace width	Number of specimens	Mean carapace length	Mean carapace width
	<i>Milli-meters</i>	<i>Milli-meters</i>		<i>Milli-meters</i>	<i>Milli-meters</i>		<i>Milli-meters</i>	<i>Milli-meters</i>
57	4.2	4.2	-----	-----	-----	-----	-----	-----
89	5.0	5.1	-----	-----	-----	-----	-----	-----
78	6.0	6.2	15	6.2	6.0	-----	-----	-----
76	7.0	7.3	-----	-----	-----	6	6.9	7.7
76	8.0	8.3	8	8.3	8.3	-----	-----	-----
53	9.0	9.4	-----	-----	-----	8	8.7	9.8
46	10.0	10.4	-----	-----	-----	-----	-----	-----
22	10.9	11.2	-----	-----	-----	-----	-----	-----
9	12.4	12.7	11	11.8	11.6	6	12.3	13.9
10	14.3	14.7	12	14.1	14.2	16	14.0	15.8
-----	-----	-----	-----	-----	-----	7	15.5	17.4
9	17.0	17.3	10	17.3	17.2	5	17.6	19.9
-----	-----	-----	2	22.6	22.5	-----	-----	-----

TABLE 3.—Mean values of total length of three distal segments of second walking leg

<i>Planes minutus</i>			<i>Planes cyaneus</i>			<i>Pachygrapsus marinus</i>		
Number of specimens	Mean carapace length	Mean length of leg segments	Number of specimens	Mean carapace length	Mean length of leg segments	Number of specimens	Mean carapace length	Mean length of leg segments
	<i>Milli-meters</i>	<i>Milli-meters</i>		<i>Milli-meters</i>	<i>Milli-meters</i>		<i>Milli-meters</i>	<i>Milli-meters</i>
16	4.2	4.1	-----	-----	-----	-----	-----	-----
46	5.0	5.0	-----	-----	-----	-----	-----	-----
46	6.0	6.0	15	6.3	5.1	-----	-----	-----
52	7.0	7.0	-----	-----	-----	4	7.3	6.8
54	7.9	7.8	8	8.2	6.6	-----	-----	-----
45	8.9	8.7	-----	-----	-----	7	8.7	7.8
41	9.9	9.6	-----	-----	-----	-----	-----	-----
21	10.9	10.3	12	11.6	9.0	-----	-----	-----
15	12.6	11.6	-----	-----	-----	6	12.3	10.4
12	14.5	13.0	12	14.1	10.5	16	14.0	11.8
12	16.3	14.4	-----	-----	-----	7	15.5	12.8
4	18.3	16.0	10	17.0	13.1	5	17.6	14.2
-----	-----	-----	5	22.5	16.9	-----	-----	-----

shorter legs may be better adapted to this more sessile existence or, conversely, the longer legs of the smaller individuals may be advantageous in scurrying and swimming about among the floating weed. Whether there is a gradual reduction in the relative lengths of the legs with the transfer of the animal to a different means of transport or whether there are two forms of *Planes* in the North Atlantic—a small, trapezoidal form that spends its entire life on floating weed and a larger, laterally convex, and short-legged form that lives only on flotsam and turtles—can be determined only when more material,

particularly of immature specimens, from flotsam and turtles is available for study.

Similar trends are not apparent in the specimens of *Planes cyaneus* or *Pachygrapsus marinus*, but the relative growth of these two species cannot be reliably demonstrated from the material studied.

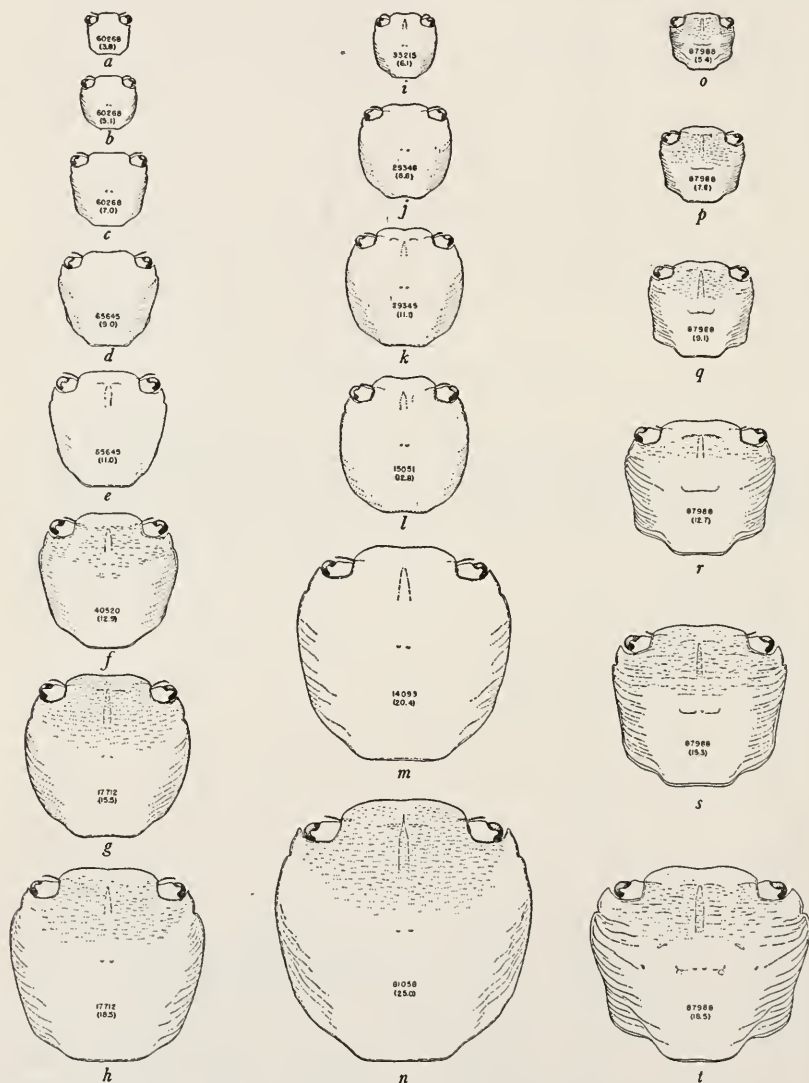


FIGURE 3.—Carapace growth in males of *Planes minutus* (a-h), *Planes cyaneus* (i-n), and *Pachygrapsus marinus* (o-t). The figures denote the U.S.N.M. catalog numbers and, in parentheses, the carapace lengths in mm.



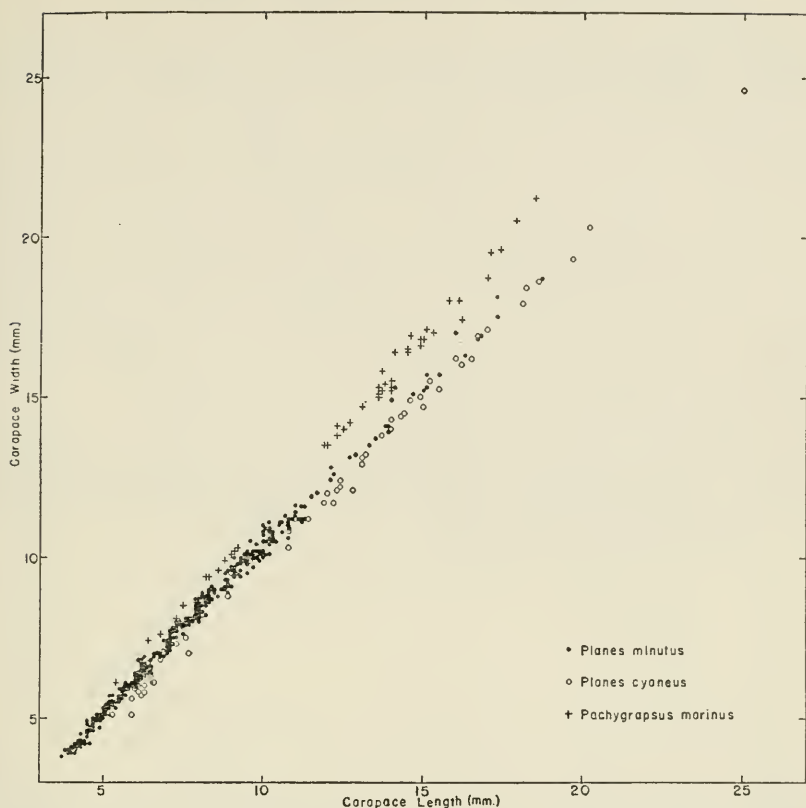


FIGURE 4.—Scatter diagram showing the variation in proportions of the carapace in *Planes minutus*, *Planes cyaneus*, and *Pachygrapsus marinus*.

### COLOR

The variable and protective coloration of *Planes minutus* has been a cause of speculation for more than a century. Some of the early workers believed that those specimens which were greenish or brownish yellow mottled with darker shades of the same color sought out *Sargassum* clumps to live on in order to be less conspicuous to their enemies. These *Sargassum* inhabitants also often have a large white or yellowish patch on the dorsal surface, which seems to duplicate the patches of bryozoan colonies with which the plant fronds are almost invariably encrusted. Those specimens found on turtles are usually yellowish, those on logs and drifting trees often dark reddish brown, and those on the pelagic gastropod *Janthina* lilac blue. Light reddish shades have also been recorded on several occasions. Examples of some of these colors are shown in Murray and Hjort (1912, pl. 6).

Müller (1881, p. 473) was apparently the first to suggest that these crabs change their color according to the object to which they cling.

Not until a few years ago, however, was the nature of this change demonstrated. Dr. Hitchcock (1941, pp. 26-30) found that the chromatophores of specimens of *P. minutus* he investigated at Bermuda were responsive to white, black, red, blue, yellow, and green backgrounds, but that there was no immediate change in the general color of the crab because of the extracellular pigment in the hypodermis and exoskeleton. These findings seem to indicate that the apparent color of any particular specimen can be changed only at the time of molting, and any individual that moves to a differently colored background subsequent to hardening of the shell would cease to be protectively colored. Interesting results might be obtained by confining molting specimens to backgrounds of various colors and patterns.

The color of *P. cyaneus* has been recorded as cerulean blue, bluish gray mottled with brown, yellowish clouded with brown, and reddish brown. It is probable that a type of color change comparable to that in *P. minutus* occurs in this species as well, although no similar experiments on it have been attempted.

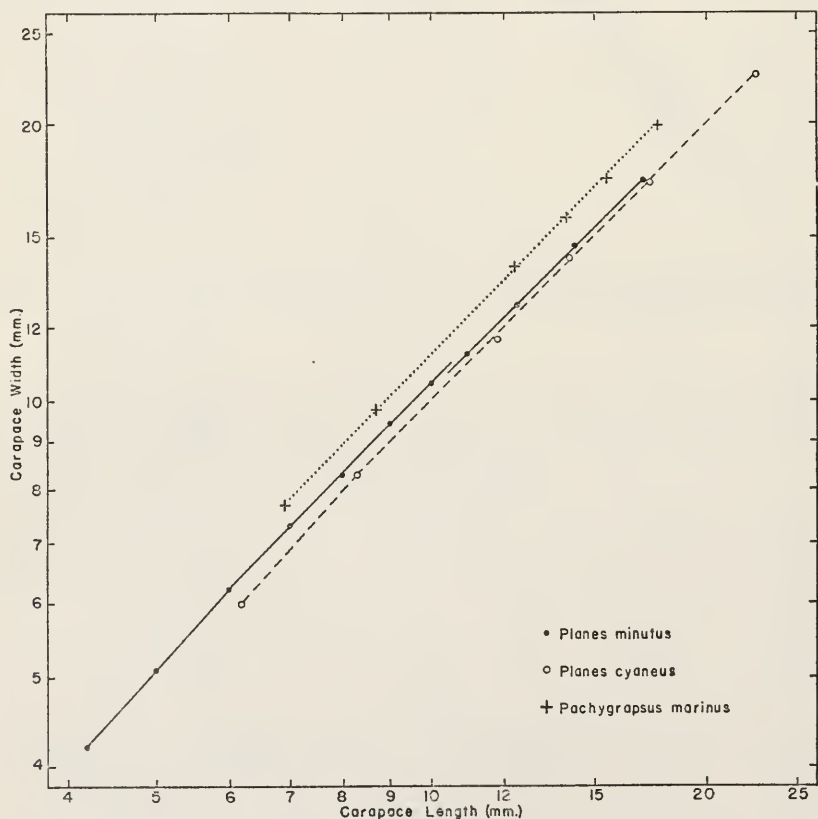


FIGURE 5.—Relative growth of the carapace in *Planes minutus*, *Planes cyaneus*, and *Pachygrapsus marinus*, based on mean values (table 2) plotted logarithmically.

The color in life of *Pachygrapsus marinus* has not been published. The specimens from a Japanese mine which prompted this survey were rather dark reddish brown a short time after preservation in alcohol.

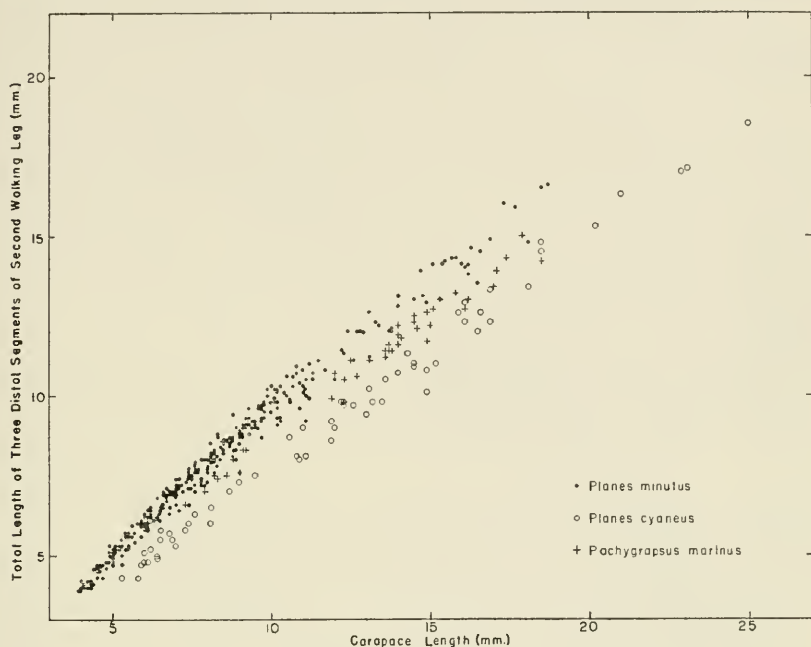


FIGURE 6.—Scatter diagram showing the variation in the combined length of the three terminal segments of the second walking leg in *Planes minutus*, *Planes cyaneus*, and *Pachygrapsus marinus*.

### FOOD

The only published record of the stomach contents of any of these species is that of Miss Crane (1937, p. 78) based on a large ovigerous female of *Planes cyaneus* taken from the tail of a green turtle. The stomach of this specimen contained finely digested animal matter. Miss Crane suggests the possibility that this food material might represent the excrement of the turtle. Some support is given to this theory by the fact that larger specimens of *Planes* are commonly found around the tail and hind legs of turtles. Specimens living on other objects, however, must be able to assimilate less digested food.

### DISTRIBUTION

The relative abundance of these oceanic crabs is more or less dependent upon the prevalence of flotsam or of floating or swimming organisms to which the crabs may cling. They are therefore found far more commonly on *Sargassum* in the Sargasso Sea area of the North Atlantic than in any other part of the world. Records of their occur-

rence in other areas are still too scattered and frequently too unreliable to justify the usual distribution note that *Planes* is "found in all tropical and temperate seas."

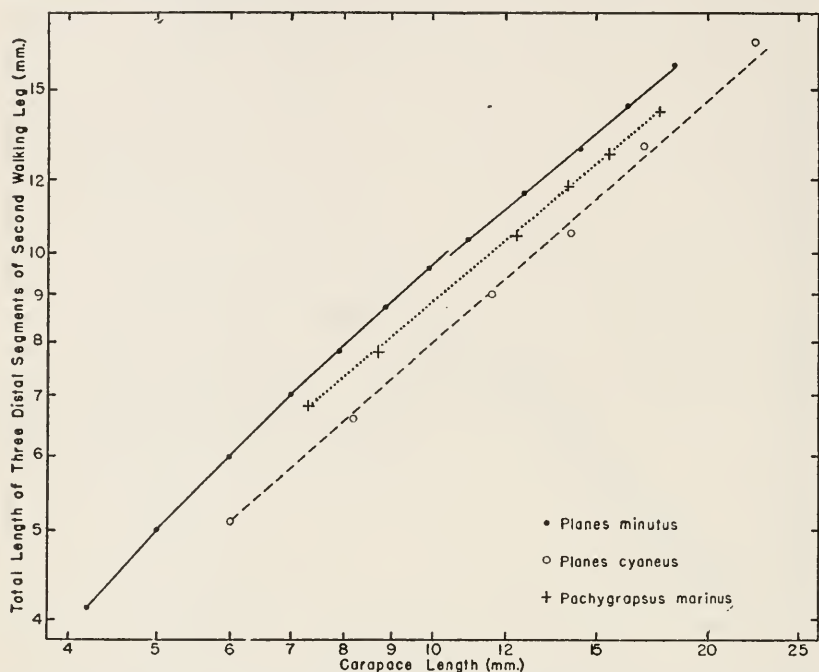


FIGURE 7.—Relative growth of the three terminal segments of the second walking leg in *Planes minutus*, *Planes cyaneus*, and *Pachygrapsus marinus*, based on mean values (table 3) plotted logarithmically.

The more reliable locality records for the species of *Planes* are indicated in figure 8. Not included on this chart are several references in the literature to Australian specimens without specific locality data. Even some of the localities indicated, particularly those from older records, require verification. It is obvious that in some cases specimens picked up at sea have been referred to the last port of call of the vessel involved. The large lot of specimens recorded by Dr. Rathbun (1918, p. 257) from the Galápagos Islands (U.S.N.M. No. 5046) prove to belong to the Atlantic *Planes minutus*. This determination is substantiated by the fact that the shrimp from the same collection belong to the *Sargassum* fauna of the North Atlantic. Similar circumstances may explain the record of the single specimen of *P. cyaneus* from Mauritius (U.S.N.M. No. 17667) if the presence of *P. minutus* alone in the Indian Ocean is borne out by other material. Even one of the lots of *P. minutus* from that region, that from Kerguelen Island (U.S.N.M. No. 15054), is questionable; in the collections of



the U. S. National Museum is a specimen of *Portunus* (*Portunus*) *sayi* (Gibbes) that bears the same locality data, and this crab is otherwise reliably reported only from the Atlantic. Examination of additional material from the Indian Ocean will be necessary before it can be definitely ascertained whether one or both species occur there. The fact that Alcock (1900) recorded no specimens of the genus indicates that it is not a common component of the Indian fauna.

One of the most interesting aspects of the distribution of *Planes* is its apparent absence from the Gulf of Mexico west of the Dry Tortugas despite its relative abundance from the Straits of Florida eastward and its occurrence in the Caribbean area. Joel W. Hedgpeth, of the Institute of Marine Science at Port Aransas, Tex., and Dr. Allan F. Archer, of the Alabama Museum of Natural History, inform me that they have never encountered the crab although they have searched through great masses of *Sargassum* from the Gulf. It would be interesting to know what factor or factors preclude the dispersion of *Planes* into an area such as this where the presence of floating weed and particularly of sea turtles would seem to afford ideal sources of attachment for the crabs.

There are likewise very few records of the presence of *Planes* in the central South Atlantic, possibly because of the comparatively small amount of exploratory work done in that extensive region. If the occurrence of *P. minutus* in the Indian Ocean is finally confirmed, it would be of considerable interest to know more of the distribution of the genus in the South Atlantic, particularly whether the Pacific *P. cyaneus* extends into the western part of the South Atlantic and, if it does, whether the ranges of the two species overlap there. Inasmuch as *Planes* is not infrequently found among the under-water growth on ships' hulls and as the crabs are said to be common in the Straits of Magellan (Jacquinot and Lucas, 1853, p. 78), through which much of the steamship traffic passed in the early part of this century, it would be remarkable if intermingling of the two forms had not occurred commonly in the past.

The known distribution of *Pachygrapsus marinus* is limited to the records from the coast of Oregon and the Hawaiian Islands, in addition to the type locality west of Baja California; further collecting will probably show its range to be far more extensive in the eastern North Pacific and possibly in the western portion as well. Dr. C. H. Edmondson informs me that, of 18 lots and 150 or more specimens identified as *Planes minutus* in the Bernice P. Bishop Museum, 3 lots containing a total of 22 specimens are apparently *Pachygrapsus marinus* and 3 of the remaining 15 lots contain both *Planes* and *Pachygrapsus*, including 30 or more specimens of the latter. All the lots containing *Pachygrapsus marinus* were taken off Oahu.

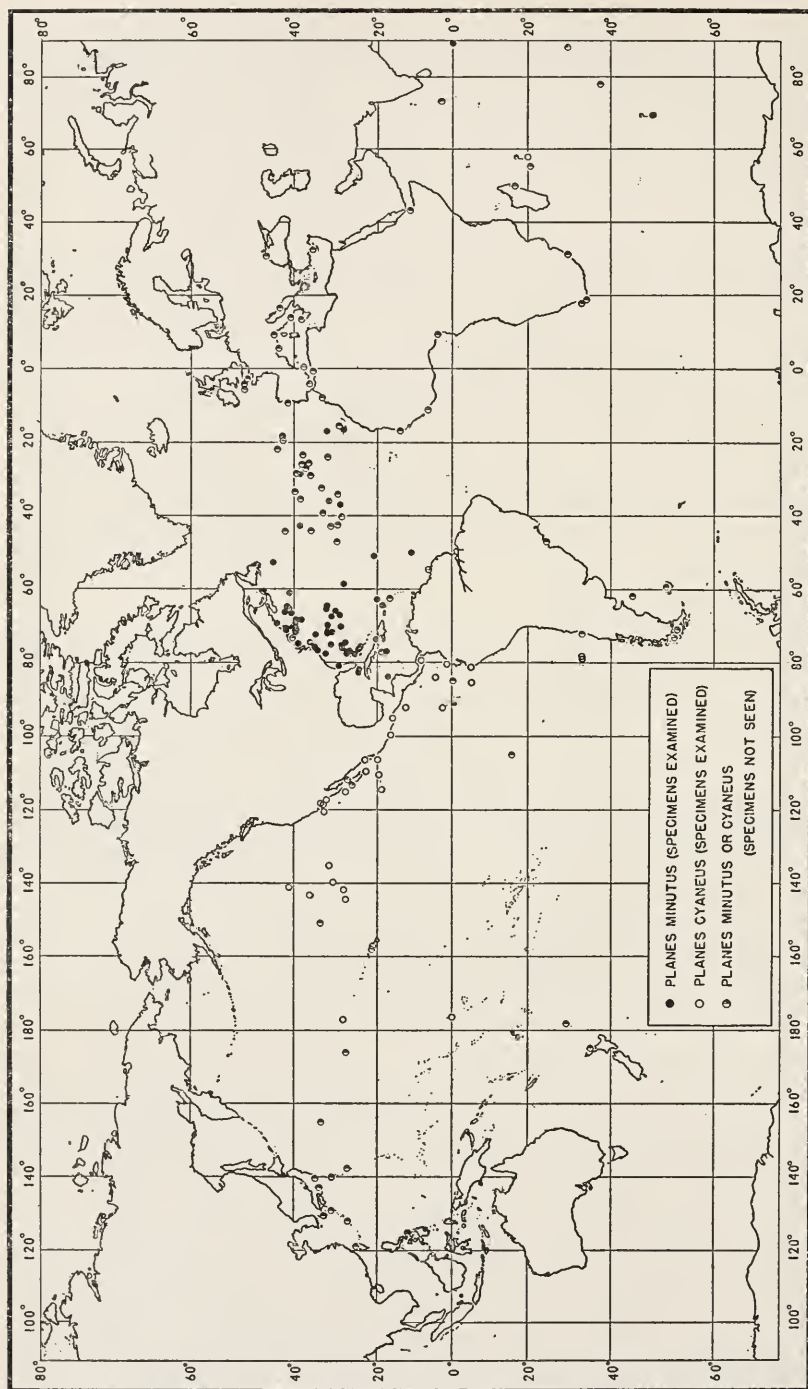


FIGURE 8.—Known distribution of the species of *Planes* based only on locality records that are apparently valid and reasonably exact.

## Genus PLANES Bowdich

## PLANES MINUTUS (Linnaeus)

- Cancellus marinus minimus quadratus* SLOANE, 1725, p. 270, fig. 1 ("on the Sargasso and other Submarine Sea-Plants, on the Northside of Jamaica").
- Cancer minutus* LINNAEUS, 1758, p. 625 ("Habitat in Palgi *Fuco natante*, supra aquam saepius cursitans"); 1767, p. 1040 [2040] (west Europe and "*Pelagi Fuco natante*").—OSBECK, 1771, p. 116 (Sargasso Sea).—FABRICIUS, 1775, p. 402.—MÜLLER, O. F., 1776, p. 195.—PENNANT, 1777, p. 3, pl. 1, fig. 2 (British shores, among algae).—FABRICIUS, 1781, p. 497.—HERBST, 1783, p. 110, pl. 2, fig. 32.—FABRICIUS, 1787, p. 316.—OLIVIER, 1791, pp. 143, 154.—FABRICIUS, 1793, p. 443 ("In Pelago frequens").
- Cancer pusillus* FABRICIUS, 1775, p. 402 ("in Oceano boreali").—HERBST, 1783, p. 112.—FABRICIUS, 1787, p. 316.—OLIVIER, 1791, pp. 143, 155.—FABRICIUS, 1793, p. 443.
- Turtle-Crab BROWNE, 1789, p. 421, pl. 42, fig. 1 ("on the back of a turtle, near the western islands").
- Pinnotheres glaberimus* Bosc, 1801-02, p. 244 ("dans la haute mer sur les fucus").  
Not *Cancer glaberrimus* Herbst, 1790.
- Pinnotheres minutus* Bosc, 1801-02, p. 244.
- Pinnotheres pusillus* Bosc, 1801-02, p. 244.
- Grapsus minutus* LATREILLE, 1802-03, p. 68.—LEACH, 1814, p. 430.
- Grapsus cinereus* SAY, 1817, p. 99 (Gulf Stream, common). Not *G. cinereus* Bosc, 1802.
- Grapsus pelagicus* SAY, 1818, p. 442.—ROUX, 1828, p. 55, pl. 6, figs. 7-9 (off Sardinia, on turtles).—HITCHCOCK, E., 1835, p. 29 (Gulf Stream, on seaweed).—THOMPSON, J. V., 1836, p. 374 (off America, on gulfweed, abundant).—MILNE-EDWARDS, H., 1852, p. 174.
- Planes clypeatus* BOWDICH, 1825, p. 15, pl. 12, figs. 2a-b (northeast of Madeira, on water-logged logs of American pine, in great numbers among *Lepas anatifera*).
- Grapsus testudinum* ROUX, 1828, p. 52, pl. 6, figs. 1-6 (under folds of skin of legs and anus of turtles).
- Nautilograpsus minutus* MILNE-EDWARDS, H., 1837, p. 90.—MACLEAY, 1838, p. 66 (Atlantic, on gulfweed).—KRAUSS, 1843, p. 44 (Gulf Stream).—DE KAY, 1844, p. 15 (off New York harbor, on seaweed).—GOODSIR, 1845, p. 73, pl. 7, fig. 1 (lat. 25° to 36° N., long. 40° W.; lat. 40° N.).—GIBBES, 1850, p. 182 [18].—MILNE-EDWARDS, H., 1852, p. 174.—STIMPSON, 1858, p. 103 [49] (North Atlantic, common in *Sargassum*).—MILNE-EDWARDS, A., 1862, p. F-6 (Réunion Island, Indian Ocean).—HELLER, 1863, p. 114 (African coast of Mediterranean; Cyprus; Genoa; Lesina); 1865, p. 50 (Sargasso Sea).—SMITH and HARGER, 1874, p. 26 (off Georges Bank; lat. 41°25' N., long. 65°05'-30' W.).—BROCCHI, 1875, p. 80, pl. 17, fig. 133.—MAN, 1879, p. 69 (part: Atlantic Ocean).—MOSELEY, 1879, p. 568 (Sargasso Sea, on *Sargassum*).—SMITH, 1879, p. 120 (Bermuda; lat. 41°20'-30' N., long. 65° to 65°30' W.); 1880, p. 263 (Woods Hole, Mass.).—STOSSICH, 1880, p. 192 (Lesina).—WAGNER, 1880, p. 96.—KINGSLEY, 1881, p. 202 (part: Gulf Stream; West Indies; Surinam; Falkland Islands [?]; Natal; Rio Gambia; France).—CZERNIAVSKY, 1884, p. 135 (Odessa).—MILNE-EDWARDS, A., 1884, p. 25 (Sargasso Sea, on *Sargassum*).—CARUS, 1885, p. 524.—VERRILL, 1885, p. 591 (Gulf Stream, common, usually clinging to clusters of floating seaweeds).—MIERS, 1886, p. 254 (part: Gomera, Canary Islands; between Bermuda and Azores; off Sombrero Island, West Indies; northwest Atlantic,

- on gulfweed; North Atlantic, on *Fucus*).—POUCHET and GUERNE, 1886, p. 878 (Azores, from stomach of turtle, *Thalassochelys caretta*).—SMITH, 1886, p. 618.—BARROIS, 1888, p. 15 (Ponta-Delgada, Sao Miguel, Azores, on timber).—GOURRET, 1888, p. 10 (Marseilles, on ships from the Atlantic and the Indies).—HEILPRIN, 1888, p. 320 (off Shelly Bay, Bermudas).—CHEVREUX and GUERNE, 1893, pp. 443-444 (lat. 37°55' N., long. 0°40' E., clinging to tail of turtle, *Thalassochelys caretta*; lat. 37°26' N., long. 0°50' E., clinging to tail of *Thalassochelys*).—ORTMANN, 1893, p. 58 (Florida Stream, on *Sargassum*; Sargasso Sea, on *Sargassum*; South Equatorial Current).—MILNE-EDWARDS, A., and BOUVIER, 1894, p. 49 (lat. 39°08' N., long. 28°34' W., on floating barrel; lat. 42°21'29'' N., long. 18°33'45'' W.; lat. 42°31'21'' N., long. 19°38'08'' W.; lat. 43°29'30'' N., long. 21°33'40'' W., on flotsam; Fayal, Horta, Azores, on rocks at low tide; lat. 42°02'26'' N., long. 44°05'30'' W., on *Sargassum*; lat. 39°20'30'' N., long. 33°29'40'' W., on flotsam).—ORTMANN, 1894, p. 710 (Oran; Africa; Atlantic Ocean; "Sargasso").—NUTTING, 1895, p. 29 (Gulf Stream, in *Sargassum*).—HODGSON, 1896, p. 178 (Plymouth Sound, England, on bottom of ship from Iquique, Peru; English Channel, 2-3 miles off Plymouth, on fragment of cork structure).—MILNE-EDWARDS, A., and BOUVIER, 1899, p. 37 (lat. 37°16-39' N., long. 27°05-58' W., on turtles, *Thalassochelys caretta*; lat. 39°12' N., long. 33°09' W., on flotsam; lat. 38°08' N., long. 25°55' W., on flotsam; lat. 38°26' N., long. 28°51' W.); 1900, p. 108 (off Ponte-Delgado, on *Sargassum*).—RANKIN, 1900, p. 526 (Bermuda, in tide-pools with *Pachygrapsus* among *Sargassum*).—YOUNG, 1900, p. 286 (part: not all distribution records).—HOWE, 1900, p. 240 (approx. lat. 40° N., long. 70° W.).—NORMAN and SCOTT, 1906, p. 5.—BOUVIER, 1907, p. 37 (variable coloration).—COULON, 1907, p. 123 [17] (Sargasso Sea).—NORMAN, 1907, p. 357 (Channel Islands).—STIMPSON, 1907, p. 121 (North Atlantic, between lat. 20-36° N., common on floating logs, seaweed (*Sargassum*), etc.).—NORMAN and BRADY, 1909, p. 9.—PESTA, 1918, p. 446, fig. 147 (Lesina).—BORASCHI, 1921, p. 10, pl. 1, fig. 9 (larvae: Quarto dei Mille; Palermo).—MIRANDA y RIVERA, 1921, p. 189 (Playa de la Malagueta, Spain).—MONOD, 1932, p. 219 (Fedhala, Morocco, common on marine plants and other objects).
- Nautilograpsus major* MACLEAY, 1838, p. 66 (Cape of Good Hope).—KRAUSS, 1843, p. 44.—MILNE-EDWARDS, H., 1852, p. 175.
- Nautilograpsus smithii* MACLEAY, 1838, p. 67 (Cape of Good Hope).—KRAUSS, 1843, p. 44.—MILNE-EDWARDS, H., 1852, p. 175.
- Grapsus diris* COSTA, 1838-53, [p. 2, pl. 4, fig. 1 (color)] (Naples, "among rocks above water").—MILNE-EDWARDS, H., 1852, p. 175.
- Planes linnaeana* LEACH, 1815, pl. 27, figs. 1-3, and accompanying text (coasts of Devon and Cornwall).—BELL, 1844-53, p. 135, figs. (Devonshire; Cornwall).—WHITE, 1847, p. 41 (Devonshire; south Atlantic).—COCKS, 1849, p. 80 (Falmouth, England, from stomach of fish).—WHITE, 1850, p. 19 (Devonshire).—GOSSE, 1855, p. 159, fig. 302.—MCANDREW, 1860, p. 21.—LUKIS and LE LIEVRE, 1862, p. 232 (Guernsey, Channel Islands).—MARCUSEN, 1867, p. 359 (Black Sea).—CARRINGTON and LOVETT, 1882, p. 181 (Looe, Cornwall, among stalked barnacles on timber; Penzance, from soil and seaweed on derelict cask of paraffin).—CORNISH, 1882, p. 118 (off Penzance, England, from soil and seaweed growing on derelict cask of paraffin); 1884, p. 116 (near Penzance, England, from derelict water-logged barrel of paraffin drifted ashore).
- Planes minutus* WHITE, 1847, p. 42 ("Gulf of Florida;" Atlantic Ocean, on gulfweed).—DANA, 1852b, p. 346; 1854, p. 27.—CUNNINGHAM, 1870, p. 493



(south of Azores, on *Sargassum*); 1871, p. 501.—RATHBUN, 1897b, p. 29 (Kingston Harbor, Jamaica); 1898a, p. 288 (Dry Tortugas, in gulfweed; lat. 31°30' N., long. 75°11' W.); 1898b, p. 604, (part: lat. 31°16' N., long. 71°50' W.).—ORTMANN, 1899, p. 1188 (part).—RATHBUN, 1900a, p. 279; 1900b, p. 587 (part).—THOMPSON, D'A. W., 1901, p. 6 (Atlantic).—BORRADAILE, 1903, p. 432 (Male, Maldive Islands, on floating cuttlebone).—DOFLEIN, 1904, p. 130 (lat. 30°6.7' S., long. 87°50.4' E.).—MAYER, 1905, p. 102.—STEBBING, 1905, p. 43 (False Bay, South Africa).—RATHBUN, 1905, p. 4 (Woods Hole and Wareham, Mass.; Sakonnet Point, R. I., under rocks).—NOBILI, 1906, p. 321 (Djibouti).—VERRILL, 1908, p. 325, fig. 7, pl. 13, figs. a-j', pl. 27, fig. 6 (off Bermuda).—LENZ, 1910, pp. 560, 574 (Ste. Marie, Madagascar).—STEBBING, 1910, p. 320 (South Africa: False Bay; 38 miles northwest of Rable Bay).—DOFLEIN and BALSS, 1912, p. 39 (part ?; lat. 44°32' S., long. 61°25' W.).—FOWLER, 1912, p. 443, pls. 140-141 (Cape May, N. J.).—MURRAY and HJORT, 1912, pp. 103, 633, 671, pl. 6 (color) (approx. lat. 36°05' N., long. 43°58' W.).—PESTA, 1912, p. 122 (Lesina).—SUMNER, OSBURN, and COLE, 1913, p. 675 (western part of Vineyard Sound, Mass., commonly on gulfweed).—LENZ and STRUNCK, 1914, p. 284 (off Madeira, on floating weed; off New Amsterdam Island, on *Macrocystis*; southeast of Madagascar; south of Azores, on *Sargassum*).—STEBBING, 1914a, p. 345 (Falkland Islands); 1914b, p. 266, pl. 24 (Saldanha Bay, South Africa; lat. 29°54' N., long. 34°10' W. to lat. 33°53' N., 32°27' W.).—BOUVIER, 1915, p. 127 (Port Louis, Mauritius).—HAY and SHORE, 1918, p. 448, pl. 36, fig. 6 (Beaufort, N. C.).—RATHBUN, 1918, p. 253 (part: off Woods Hole, Mass., to Florida and Bahamas; Azores; Indian Ocean; Kerguelen Island).—TESCH, 1918, p. 83 [footnote] (part: not all distribution records).—CROZIER, 1918, pp. 262-263 (Bermuda, on floating tree; coloration).—LUEDERWALDT, 1919, p. 435 (Iguape, São Paulo, Brazil).—BALSS, 1922a, p. 83 (Monrovia, West Africa).—BOUVIER, 1922, p. 74, pl. 2, fig. 2 (color) (east-central North Atlantic between lat. 28° and 39° N., and long. 23° and 43° W., on turtles, *Sargassum*, floating wood, etc.).—HYMAN, 1924, p. 5, pl. 1, figs. 1-10 (Beaufort Harbor, N. C.).—RATHBUN, 1924, p. 157 (off eastern Cuba, on *Sargassum*).—MONOD, 1927, p. 621 (Souelaba, Douala Bay, Cameroon, on floating tree trunk).—PERKINS, 1928, p. 53.—RATHBUN, 1929, p. 35, fig. 48 (off Nova Scotia).—NOBRE, 1931, p. 107, figs. 60-63 (Douro River, Portugal, on root of tree washed in by storm).—MONOD, 1933, p. 80.—RATHBUN, 1933, p. 89, fig. 83 (Puerto Rico; St. Thomas).—EKMAN, 1935, pp. 9, 425 (part, not fig.).—NOBRE, 1936, p. 63, pl. 24, fig. 45, pl. 46, fig. 45a.—MONOD, 1939, p. 567 (lat. 30°10' N., long. 47° W., on *Sargassum*).—BOUVIER, 1940, p. 291, fig. 182.—HITCHCOCK, H. B., 1941, pp. 26-30 (Bermuda; color change).—LEBOUR, 1944, p. 114, fig. 4 (Bermuda, in *Sargassum*; larvae).—ZARIQUIEY ALVAREZ, 1946, p. 163, pl. 18, fig. b.

*Nautilograpsus diris* HELLER, 1863, p. 115.

*Nautilograpsus pelagicus* HELLER, 1863, p. 115.

*Nautilograpsus cyaneus* TARGIONI TOZZETTI, 1872, p. 8 (Sargasso Sea); 1877, p. 125, pl. 8, figs. 5a-f (Atlantic Ocean). Not *Planes cyaneus* Dana, 1852.

*Planes linneana* COUCH and BATE, 1878, p. 469 (English Channel off French coast, under tail of hawksbill turtle; Devon or Cornwall).

*Nautilus grapsus minutus* MORISON, 1942, p. 269.

*Planes* sp. WHITE, 1847, p. 42 (St. Kitts Island; Falkland Islands; Brazil; Swan River).—BEEBE, 1932, pp. 188-196 (Bermuda).

*Nautilograpsus* sp. MÜLLER, F., 1881, p. 473 (color change).

TABLE 4.—*Material examined of Planes minutus* 1

Locality	Latitude N.	Longitude W.	Sur-face temp.	Date	Station	Collector	Specimens	Catalog No.	Remarks
Off eastern North America south of Newfoundland.	44 29 --	52 53 --	° F.	Sept. 21, 1935		A. H. Leim.	1 ♂	72195	
Maine:									
New Harbor, Muscongus Bay.	-- --	-- --		Aug. 15, 1944		L. W. Scattergood	1 ♂	88063	From loggerhead turtle.
Massachusetts:									
Georges Bank	41 52 --	66 24 --		Sept. 16, 1927		W. C. Schroeder	1 ovig. ♀	8720 (MCZ)	
Vicinity of Woods Hole.	-- --	-- --		1899		B. A. Bean	1 ♂	44672	
Wareham	-- --	-- --		Aug. 12, 1898		Outran Bangs	1 ♂	5676 (MCZ)	Found alive on beach.
Rhode Island:									
Sakonnet Point.	-- --	-- --		Sept. 13, 1904		W. Nye, Jr.	1 ovig. ♀	31476	Under rocks.
5-6 miles off Block Island.	-- --	-- --		July 30, 1928		A. K. Fisher	1 ♂ 1 ovig. ♀	62510	From hawkbill turtle.
New Jersey:									
East of	40 50 --	60 53 --		July 2, 1915		C. W. Furlong, Kitty A.	7 ♂ 2 ♀	53351	From <i>Sargassum</i> .
Do.	40 34 30	66 48 00	67	July 14, 1885	2532	Albatross	1 ♀	11088	
Do.	40 10 15	70 26 00	64	Sept. 26, 1884	2243	Albatross	3 ♂ 2 ♀ (1 ovig.)	7285	
Do.	39 59 40	70 41 10	68	Sept. 20, 1883	2090	Albatross	1 ovig. ♀	5422	
Do.	39 45 00	69 44 45	70	Aug. 4, 1881	935	Fish Hawk	2 ♂ 1 ♀	4558	1 male figured.
Do.	39 49 25	69 49 00	72	do.	937				
Do.	39 40 --	71 30 --	68	Sept. 8, 1881	994	Fish Hawk	1 ♀	40519	
Do.	39 34 15	71 41 15	74	Aug. 19, 1884	2203	Albatross	4 ♂ 2 ovig. ♀	8220	
Do.	39 29 00	70 58 40	69.5	Sept. 30, 1883	2095	Albatross	1 ♂	15052	
Do.	39 22 50	68 25 00	72	July 30, 1883	2041	Albatross	4 ♂ 3 ovig. ♀	6515	
Cape May Point.	-- --	-- --		Sept. 24, 1928		H. G. Richards	1 ♀	74887	
Maryland:									
East of	38 19 26	68 20 20	81	July 23, 1883	2039	Albatross	2 ♂	40520	Carapace of smaller specimen figured.
North Carolina:									
East of	36 20 24	74 46 30	69	June 4, 1885	2425	Albatross	1 ♂ 2 ♀	17896	
Edge of Gulf Stream off Cape Hatteras.	-- --	-- --		June 6, 1903		B. A. Bean	5 ♂ 6 ovig. ♀	31080	From <i>Sargassum</i> .
200 miles off Cape Hatteras.	-- --	-- --		Oct. 1921		Carnegie	16 ♂ 15 ♀ (2 ovig.)	60268	Carapaces of three males figured.

Beaufort.	32	43	00	77	51	00	69	July 16, 1912.	W. P. Hay, Fish Hawk.	1♂ 1♀	51019
Do.	--	--	--	--	--	--	--	--	Kingsey (?)	2♂ 1♀	56798
South Carolina:											
East of.	32	43	00	77	51	00	69	Jan. 5, 1885.	Albatross.	7♂ 7♀ (1 ovig.) 1 megalops.	15053
Do.	32	33	--	72	14	--	66.5	Jan. 30, 1914.	Bache.	1♀	49957
Do.	32	29	--	71	29	--	66.1	Feb. 1, 1914.	Bache.	5♂ 4♀	49942
Do.	32	27	--	69	55	--	66.1	Feb. 2, 1914.	Bache.	9♂ 6♀	49946
Georgia:											
East of.	31	30	--	75	11	--	--	May 9, 1893.	University of Iowa Bahama Expedition.	1♂ 1♀	74517
Florida:											
St. Augustine.	31	16	--	71	50	--	--	Nov. 23, 1887.	Albatross.	19♂ 19♀	22098
Florida Keys.	--	--	--	--	--	--	--	--	E. Samuels.	1♂ 1 ovig. ♀	71132
Key West.	--	--	--	--	--	--	--	--	Albatross.	2♂ 6♀ (4 ovig.)	5977 (MCZ)
Dry Tortugas.	--	--	--	--	--	--	--	Apr. 15-27, 1884.	University of Iowa.	1♀	18448
Bahamas and West Indies	--	--	--	--	--	--	--	--	--	1♂	68857
Bahamas:											
Northeast of Abaco Island.	28	51	--	75	13	--	70.8	Feb. 28, 1914.	Bache.	1♀	49940
Do.	28	--	--	75	--	--	--	June 15, 1903.	Bean and Riley	3♂ 2 ovig. ♀	31061
About 120 miles north by east of Abaco Island.	--	--	--	--	--	--	--	--	do.	6♂ 18♀ (10 ovig.)	31081
60 miles north of Abaco Id.	--	--	--	--	--	--	--	June 16, 1903.	B. A. Bean.	5♀ (4 ovig.)	31079
North of Abaco Island.	27	57	30	77	27	30	73	May 2, 1886.	Albatross.	5♂ 4♀ (2 ovig.)	11399
Green Turtle Cay.	--	--	--	--	--	--	--	July 21, 1903.	E. A. Andrews.	1♂ 2♀	20714
Between Nassau and El- bow Cay.	--	--	--	--	--	--	--	--	B. A. Bean.	2♂ 1 ovig. ♀	31062
Eleuthera Island: 1 mile northeast of Governor's Harbor.	--	--	--	--	--	--	--	May 14, 1936.	W. J. Clench.	2♂ 2 ovig. ♀	9486 (MCZ)
Between Nassau and Cat Island.	--	--	--	--	--	--	--	Mar. 18, 1937.	W. L. Schmitt.	2♂	75155

See footnotes at end of table.

TABLE 4.—*Material examined of Planes minutus*!—Continued

Locality	Latitude N.	Longitude W.	Surface temp.	Date	Station	Collector	Specimens	Catalog No.	Remarks
Bahamas—Continued									
Exuma Sound	24 30 43	76 23 45	73	Mar. 13, 1886	2632	Albatross	1♂	11409	
Rum Cay				Feb. 13, 1934		T. Barbour and J. Greenway.	1♂ 3♀ (2 ovig.)	8974 (MCZ)	
Off eastern Cuba				1923	12h	Williams Galapagos Expedition.	2♀ (1 ovig.)	57739	From <i>Sargassum</i> .
Do.				1923	12j	do.	2♂	57738	
Haiti						Dr. Weinland	1♂	5982 (MCZ)	
North of St. Thomas	20	63				Dr. Kershner	7♂ 5♀ (2 ovig.)	6714	
St. Thomas				Jan. 17-24, 1884		Albatross	1♀	18563	
Do.						Hasler	23♂ 22♀ 169y	5981 (MCZ)	
Jamaica: Kingston Harbor				May-July 1896		F. S. Conant	1♂ 1 ovig. ♀	19600	
Swan Island, Caribbean Sea				1916		George Nelson	1 ovig. ♀	9077 (MCZ)	
Bermudas						F. V. Hamlin	6♂ 8♀ (1 ovig.)	4027	
Do.				1876-77		G. Brown Goode	12♂ 14♀ (4 ovig.)	43047	
Do.						Walter Faxon	1♂ 1♀	5980 (MCZ)	
Do.						Bermuda Biological Station.	9♂ 5♀	7692 (MCZ)	
Do.				Jan. 8, 1903		do.	6♂ 13♀ (7 ovig.)	8420 (MCZ)	Do.
Do.				July 2, 1903			12♂ 9♀ (6 ovig.)	9089 (MCZ)	Do.
Do.							1♀		
North shore				Mar. 10, 1916		G. Howes	15♂ 13♀ (5 ovig.)	9109 (MCZ)	In floating seaweed.
Agers Island				Jan. 12, 1882		E. Deichmann	2♂ 8♀	5170	From <i>Sargassum</i> thrown up on shore. Carapaces of 2 males figured.
				Apr. 1928			30♂ 15♀ (6 ovig.)	65645	
Hamilton Island				Mar. 3-7, 1910		T. Barbour	17♂ 12♀ (7 ovig.)	9114 (MCZ)	On beach.
South shore of Long Bird Island.				June 13-18, 1935		F. A. Chace, Jr.	1 ovig. ♀	9229 (MCZ)	
Northwest of	32 30	65 48	66.6	Feb. 5-6, 1914	10176	Bache	7♂ 3♀	49944	
Southwest of	30 27	66 05	68.2	Feb. 19, 1914	10182	Bache	3♂ 4♀ (3 ovig.)	49945	
Do.	30 27	66 05	68.2	do.	10182	Bache	1♀	49948	
Do.	29 17	67 07	68.1	Feb. 21, 1914	10184	Bache	14♂ 8♀ (3 ovig.)	49943	



Do.....	28 51 --	70 08 --	67	Feb. 24, 1914	10188	Bache.....	2♂ 2♀	49941
Do.....	28 51 --	70 08 --	67	do.....	10188	Bache.....	1♂ 1♀	49947
Do.....	31 15 42	67 39 10		Jan. 13, 1884	Hyd. 37	Albatross.....	44♂ 50♀ (4 ovig.)	7744
400 miles southeast of						Crosby.....	2 ovig. ♀	74916
Mid-Atlantic	38 50 --	42 40 --		Apr. 27, 1859		O. Dabney.....	8♂ 13♀	1593 (MCZ)
Do.....	38 50 --	42 40 --				do.....	1 ovig. ♀	8790 (MCZ)
Do.....	32 --	36 --		July 5, 1860		D. D. Rault.....	13♂ 16♀ (10 ovig.) 4y.	8787 (MCZ)
Do.....	29 23 --	37 08 --		Feb. 22, 1861		do.....	20♂ 21♀ (3 ovig.) 47y.	5990 (MCZ)
Do.....	21 --	51 --				C. C. Craft.....	1♂ 2♀	44671
Do.....	11 05 --	50 01 --				C. W. Furlong, Kitty A.....	7♂ 13♀ (3 ovig.)	53350
Azores:						O. Dabney.....	1♂ 1 ovig. ♀	5983 (MCZ)
Fayal				Jan. 1893		Lewis Dexter.....	3♂ 3♀	17712
3 miles off Fayal Harbor								From log. Parts of largest and smallest males figured.
Madeira Islands:								From floating timber.
Bay of Funchal				Aug. 1921		Adolfo Cesar de Noronha.....	1♀	55365
Do.....				Sept. 1921		do.....	1♂	55366
Canary Islands: Tenerife							3♂ 4♀ (1 ovig.)	72521
Indian Ocean.....	90° E. on Equator			Feb. 1884		Capt. J. R. Lyon, Cashmere.....	5♂ 9♀ (2 ovig.)	13914
Kerguelen Island (?)				Sept. 28, 1874		J. H. Kidder.....	1♀	15054

! Including only lots for which the locality data are apparently valid and reasonably exact.

! Unless otherwise noted, catalog numbers refer to specimens in the U. S. National Museum; (MCZ) stands for the Museum of Comparative Zoology, Cambridge, Mass.

## PLANES CYANEUS Dana

- Cancer cantonensis* LINNAEUS, 1747, p. 137, pl. 1, figs. 1a-b (Canton [?]).
- Grapsus pusillus* HAAN, 1835, p. 59, pl. 16, fig. 2.—MILNE-EDWARDS, H., 1852, p. 175. Not *Cancer pusillus* Fabricius, 1775.
- Nautilograpsus minutus* MILNE-EDWARDS, H., and LUCAS, 1843, p. 28 (record from off Valparaiso credited to Eydoux).—NICOLET, 1849, p. 168 (Valparaiso Bay).—JACQUINOT and LUCAS, 1853, p. 78 (Port Famine, Straits of Magellan, very abundant).—STIMPSON, 1860, p. 231 [103] (Cape San Lucas, Baja California).—MAN, 1879, p. 69 (part: Japan; New Guinea).—KINGSLEY, 1881, p. 202 (part: Peru; west coast of Mexico; Alaska; China; New Zealand; Falkland Ids. [?]).—MIERS, 1886, p. 254 (part: South Pacific, near Kermadec Islands, among seaweed; North Pacific, off Volcano Island; off Japan).—LENZ, 1901, p. 472 (between Honolulu and San Francisco). Not *Cancer minutus* Linnaeus, 1758.
- Planes cyaneus* DANA, 1852a, p. 250 (lat. 28° N., long. 174° E.); 1852b, p. 347 (lat. 15°50' S., long. 105° W.); 1853, p. 1593; 1855, pl. 22, fig. 1.—WARD, 1939, p. 14 (lat. 29°20' N., long. 141°25' W.).
- Nautilograpsus angustatus* STIMPSON, 1858, p. 103 [49] (lat. 34° N., long. 155° E.); 1907, p. 121, pl. 16, fig. 1 (lat. 34° N., long. 151° W.).
- Planes minutus* MIERS, 1876, p. 39 (New Zealand).—HASWELL, 1882, p. 99.—FILHOL, 1885, p. 390.—FAXON, 1895, p. 30 (lat. 00°13'00'' S., long. 84°52'00'' W.; lat. 2°34'00'' N., long. 92°06'00'' W.; off Acapulco, Mexico; all on green turtles).—RATHBUN, 1898b, p. 604 (part: 1°03' N., long. 80°15' W.; Gulf of California).—ORTMANN, 1899, p. 1188 (part).—RATHBUN, 1900b, p. 587 (part); 1902, p. 278 (about 200 miles north of Wenman Island, Galápagos, at base of tail of green turtle); 1904, p. 189 (lat. 41° N., long. 141° W.; Point Loma, Calif.; off San Diego, Calif.).—FULTON and GRANT, 1906, p. 19.—RATHBUN, 1906, p. 840 (between Erben Bank and Kaiwi Channel, on *Veella*: south coast of Oahu Island; south coast of Molokai Island, on floating stick).—RATHBUN, 1907, p. 69 (south of Gulf of California; off Guatemala; off Peru); 1910, pp. 589, 610-614, 616.—WEYMOUTH, 1910, p. 63, pl. 14, fig. 44.—CHILTON, 1911, p. 561 (Kermadec Islands).—DOFLEIN and BALSS, 1912, p. 39 (part: Smith Channel, Straits of Magellan).—RATHBUN, 1918, p. 253, pl. 63 (part: Humboldt Bay, Calif., to Peru; Galápagos Islands; Hawaiian Islands; Marquesas Islands; Japan; Mauritius).—TESCH, 1918, p. 83 [footnote] (part).—SCHMITT, 1921, p. 272, pl. 46, figs. 1-2 (La Jolla, Calif.; off Point Loma, Calif.).—BALSS, 1922b, p. 149 (Ogasawara Island).—BALSS, 1924, p. 336 (Juan Fernández Island).—URITA, 1926, p. 23 (off Ohsima, Ohsumi, Japan).—HALE, 1927, p. 181, fig. 182.—CHILTON and BENNETT, 1929, p. 768 (Moko Hinau, New Zealand, washed ashore on piece of pumice).—SIVERTSEN, 1933, p. 21.—GLASSELL, 1934, p. 302 (Gulf of California).—SAKAI, 1934, p. 323 (Japan).—EKMAN, 1935, p. 9, fig. 3 (not p. 425).—SAKAI, 1936, p. 226, fig. 120 (Japan).—AIKAWA, 1937, p. 152 (larvae).—CRANE, 1937, p. 77 (Santa Inez Bay, Mexico, on tail of green turtle; food).—SAKAI, 1939, p. 664, pl. 108, fig. 2 (Misaki, from turtle; Odawara, Sagami Bay; Simoda, on *Sargassum*; Ise Bay; Seto; Tosa Bay; Nagasaki; northern Daitozima; Tansui, Formosa).—STEINBECK and RICKETTS, 1941, pp. 45, 474 (south of Point Abrojos, Baja Calif., in folds of skin beside tail of tortoise-shell turtle, *Eretmochelys imbricata* [on flipper, p. 474]).—EDMONDSON, 1946, p. 306, fig. 183f (Hanauma Bay, Oahu Island).—POPE, 1948, pp. 296-297, fig.—RICHARDSON, 1949, p. 34, pl. 2, fig. 16. Not *Cancer minutus* Linnaeus, 1758.
- Nautilograpsus pusillus* MAN, 1879, p. 69. Not *Cancer pusillus* Fabricius, 1775.
- Planes marinus* WARD, 1939, p. 14 (lat. 32° 00' N., long. 135°20' W.; lat. 29°20' N., long. 141°25' W.). Not *P. marinus* Rathbun, 1914.

TABLE 5.—*Material examined of Planes cyaneus*<sup>1</sup>

Locality	Latitude (N.)	Longitude (W.)	Surface temp.	Date	Station	Collector	Specimens	Catalog No. <sup>2</sup>	Remarks
Off southern California;									
San Pedro			° F.			H. N. Lowe	1 ♀	32975	
Santa Catalina Island;				Oct. 22, 1910		P. S. Barnhart, <i>Anton Dohrn</i> .	1 ♀	50269	
Avalon Bay.									
WSW. of San Nicholas Island.	33 02 15	120 36 30	61-62	Mar. 28, 1904	4391	<i>Albatross</i>	1 ♀	44674	
Off San Diego	32 47 30	118 10 00	59	Jan. 23, 1889	2928	<i>Albatross</i>	1 ♂	17450	
Point Loma				Jan. 28, 1889		<i>Albatross</i>	1 ♂ 1 ♀	17449	
Off Pacific coast of Mexico:									
Baja California:									
Turtle Bay				Aug. 1, 1896		A. W. Anthony	1 ♂ 1 ovig. ♀	19517	
San José del Cabo						do	1 ♀	20694	
Gulf of California				Apr. 29, 1888		<i>Albatross</i>	2 ♂ 1 ♀	22101	
Escuinapa, Sinaloa						Dirac. Forest. y de Casa y Pesa.	1 ovig. ♀	60238	
Off Cabo Corrientes, Jalisco.	20 00 --	106 12 --	81-83	Oct. 12, 1904	4587	<i>Albatross</i>	1 ♀	33214	Male figured.
San Benedicto Island						A. W. Anthony	1 ♂ 1 ♀	20695	Walking leg figured.
Clarion Island						do	2 ♂ 3 ♀ (1 ovig.)	20700	From Green Turtle.
Off Acapulco				Feo. 10, 1891		<i>Albatross</i>	1 ♂	20624	On sand beach.
Salina Cruz, Oaxaca				Dec. 25, 1898		Chas. C. Deam	1 ♂ 1 ♀	32262	Carapace figured.
Off Guatemala	12 20 --	92 13 --	85	Oct. 17, 1904	4005	<i>Albatross</i>	1 ♂	33215	
Off Panama: Taboga Island				May 12-15, 1911		Meek and Hildebrand	1 ♂ 1 ♀	44173	
Between Panama and Galápagos Islands.	4°-5°	83°-85°		Apr. 1, 1888		<i>Albatross</i>	1 ♂	22100	
Northwest of Galápagos Islands.	2 34 00	92 06 00	82	Apr. 5, 1891	3413	<i>Albatross</i>	2 ♂ 2 ovig. ♀	4493 (MCZ)	From Green Turtle.
Off Ecuador	1 03 --	80 15 --				<i>Albatross</i>	1 ♀	22097	
Off Peru:									
Paíta				Aug. 12, 1884		W. H. Jones	1 ♂ 1 ♀	14093	Carapace of male figured.

See footnotes at end of table.

TABLE 5.—Material examined of *Planes cyaneus* 1—Continued

Locality	Latitude (S.)	Longitude (W.)	Surface temp.	Date	Station	Collector	Specimens	Catalog No. <sup>2</sup>	Remarks
Off Peru—Continued									
West of Païta	5 17	85 20	° F. 70-71	Nov. 10, 1904	4649	<i>Albatross</i>	2 ♀	33213	
Off Juan Fernández Islands, Chile.				Dec. 18, 1926		W. L. Schmitt	1 ♀	70886	
Do.				Dec. 10, 1926		do.	1 ♂	70992	
40 miles east of				Sept. 13, 1944	U-42 -204	U. S. Fish. Miss. in Chile.	1 ♂	81058	From drifting life raft. Carapace figured.
West of California	41	141		Sept. 7, 1871		W. H. Dall	1 ♂	15051	Carapace figured.
Do.	36 25	143 04		Aug. 25, 1945		M. F. Groves	8 ♀ (5 ovig)	82012	From floating wooden box.
Between California and Hawaiian Islands.	32 00	135 20				<i>Zaca</i>	1 ♂	7485 (AMNH)	Identified as <i>Planes martinus</i> by M. Ward.
Do.	30 56	139 50		Apr. 26, 1884		Lt. G. M. Stoney	3 ♂ 1 ♀	13617	
Do.	28 23 00	141 41 05	66	Mar. 19, 1902	3800	<i>Albatross</i>	1 ♂	29347	
Do.	28 23 00	141 41 05	66	do.	do	<i>Albatross</i>	1 ♂	29348	From <i>Valdella</i> .
Do.	27 55	144 15				<i>Zaca</i>	1 ♂	7484 (AMNH)	Identified as <i>P. cyaneus</i> by M. Ward.
Hawaiian Islands:									
Molokai Island: Off south coast.			76	Apr. 2, 1902	3833	<i>Albatross</i>	1 ♂	29345	From floating stick. Carapace figured.
Oahu						W. J. Thompson	1 ♂	88066	
Off south coast			74	Mar. 28, 1902	3813	<i>Albatross</i>	1 ♂	29346	Carapace figured.
Malae Kahana						C. M. Cooke, Jr.	1 ♀	88068	
Midway Island				April 1941		V. D. P. Spicer	1 ♀	88065	
Baker Island						Capt. J. Hammond	1 ♂ 3 ♀	5992 (MCZ)	One female appears to be <i>P. minutus</i> .
Mauritius				1891 (?)		H. A. Ward	1 ♀	17687	

<sup>1</sup> Including only lots for which the locality data are apparently valid and reasonably exact.<sup>2</sup> Unless otherwise noted, catalog numbers refer to specimens in the U. S. National Museum; (MCZ) stands for the Museum of Comparative Zoology, Cambridge, Mass., and AMNH for the American Museum of Natural History, New York City.



TABLE 6.—*Material examined of Pachygrapsus marinus*

Locality	Latitude (N.)	Longitude (W.)	Surface temper- ature	Date	Sta- tion	Collector	Specimens	Catalog No. <sup>1</sup>	Remarks
Oregon: Lincoln Beach	° ' "	° ' "	° F.	Dec. 29, 1947		Ordnance Officer 13th Naval District.	3♂	88069	From Japanese mine. Walking leg figured.
Do				do.		do.	1♂	(WHOD) 22833	From Japanese mine.
West of Baja California	23 49 --	127 50 --				D. D. Raulet	1♂ 1 ♀		Paratypes. Male fig- ured.
Do	23 49 --	127 50 --				do.	27♂ 14 ovig. ♀	87988	Paratypes. Carapaces of several males figured.
Hawaiian Islands:									
Oahu						C. M. Cooke, Jr.	2♂	88070	
Do				July 8, 1916		C. M. Cooke, III	1♂ 1 ♀	88064	
Mokapu				July 1, 1932		C. H. Edmondson	1♂ 1 ♀	88067	Found beside drift log.

<sup>1</sup> Catalog numbers refer to specimens in the U. S. National Museum; (WHOD) stands for the Woods Hole Oceanographic Institution, Woods Hole, Mass.

Genus **PACHYGRAPSUS** Randall**PACHYGRAPSUS MARINUS** (Rathbun)

- Planes marinus* RATHBUN, 1914, p. 120, pl. 3 (lat. 23°49' N., long. 127°50' W.); 1918, p. 258, pl. 64.—TESCH, 1918, p. 83 [footnote].—GLASSELL, 1934, p. 302.

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NEW MARINE ISOPODS, CHIEFLY FROM NORTHERN  
CALIFORNIA, WITH NOTES ON RELATED FORMS

By ROBERT J. MENZIES

IN THIS paper eight genera of marine Isopoda, including eleven species and one named variety, are described from the coast of northern California. Six of the genera are new to the fauna of the Pacific coast of North America. One genus and nine species are believed to be new to science.

In treating the janirid isopods (those included by Hansen, 1916, in his family Parasellidae) I have followed, primarily for convenience, the classification given by Nordenstam, 1933. This does not mean, however, that I advocate the use of that classification as a final one, for it has too many serious drawbacks, many of which were expressed by both Hansen and Nordenstam. At present I am not prepared to offer a new classification, to revise the old ones, or to correlate the old with the new, but I feel obligated to accept a reasonably recent classification that presumably is the best for the time being.

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## Family ANTHURIDAE

The family Anthuridae has been previously known from the west coast of North America by a single species, *Edanthura linearis* Boone. I herein consider the genus *Edanthura* (type, *E. linearis*) as a synonym of *Paranthura* and *E. linearis* as a nomen nudum. The genera *Colanthura* and *Cyathura* are apparently new to the Pacific coast fauna of North America. The three genera concerned differ so widely from one another that their identification is relatively simple, as is illustrated in the following key:

## KEY TO THE KNOWN NORTHERN CALIFORNIAN GENERA OF THE FAMILY ANTHURIDAE

- a*<sup>1</sup>. Free portion of maxilliped consisting of a single article; mandibular palp lacking; only 6 pairs of pereopods present-----*Colanthura*
- a*<sup>2</sup>. Free portion of maxilliped consisting of 2 or 3 articles; mandibular palp present; 7 pairs of pereopods present in adults.
  - b*<sup>1</sup>. Maxilliped with 2 free articles; mandibular incisor lacking chitinated teeth; mouth parts adapted for piercing and sucking-----*Paranthura*
  - b*<sup>2</sup>. Maxilliped with 3 free articles; mandibular incisor with chitinated teeth; mouth parts adapted for chewing-----*Cyathura*

## Genus PARANTHURA Bate and Westwood, 1868

In addition to the synonyms listed by Dr. Barnard in his revision of the family (1925, p. 152), another genus, *Edanthura* Boone, 1923 (type, *E. linearis* Boone, 1923, nomen nudum), should be considered as a synonym of *Paranthura*.

## PARANTHURA ELEGANS, new species

## FIGURES 9-11

*Holotype*.—Female, length 9.1 mm., width at widest part of second pereon somite 0.8 mm.

*Allotype*.—Male, length 9.0 mm., width 0.5 mm.

*Diagnosis*.—Cephalon anterolateral angles very slightly exceeding rostral forward extent. Eyes large, composed of about 13 ocelli. Endopod of uropod extending beyond telson; exopod shorter than telson and with a slightly sinuate posterolateral border. Tip of stylus of second male pleopod with four setae and marginal cylindroid lobe. Posterolateral pleotelson borders finely dentate. Maxilliped with two free articles.

*Character of body*.—Length exceeding nine times the width. Dull yellow in color with a few scattered dark-brown chromatophores.

*Cephalon*.—Rostral projection not exceeding forward extent of anterolateral angles. Eyes with about 13 ocelli. Ocular lobe with pointed apex as seen from lateral view.

*Pereon*.—Second somite slightly longer than first and with a dorsal anterior depression for the reception of the posterior border of first somite. Third somite similar to second but shorter and wider.



Fourth and fifth somites similar in length, being one-fourth longer than third somite and having a pit located anteriorly on each side of dorsolateral peraeon margin. Seventh somite one-half the length of sixth.

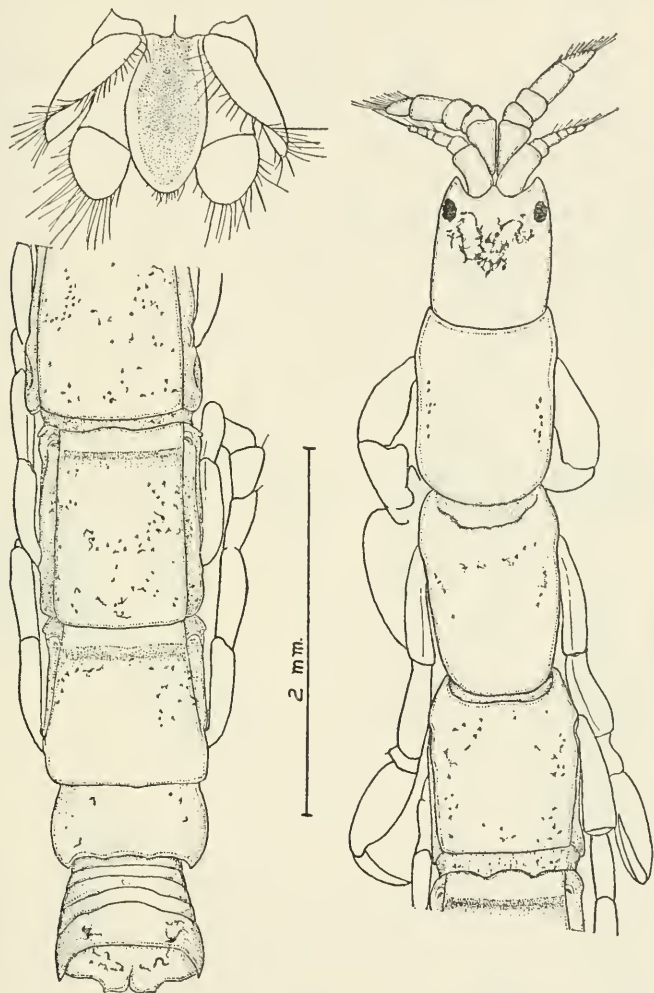


FIGURE 9.—*Paranthura elegans*, new species: Holotype. (Magnification as indicated by scale.)

*Pleon.*—Demarcation of somites visible in dorsal view. First four somites similar in length. Fifth somite three times the length of fourth. Sixth somite with a pronounced posterior median cleft. Telson elongate, with an evenly convex setiferous posterior margin and finely serrate posterolateral borders.

*First antenna.*—Composed of eight joints. Fourth joint deeply immersed in distal part of third joint.

*Second antenna*.—Peduncle composed of six joints the first three of which are partially fused with one another. Flagellum composed of a single setiferous, clavate joint bearing about three small indistinct joints at tip. Flagellum about one-half the length of sixth peduncular joint.

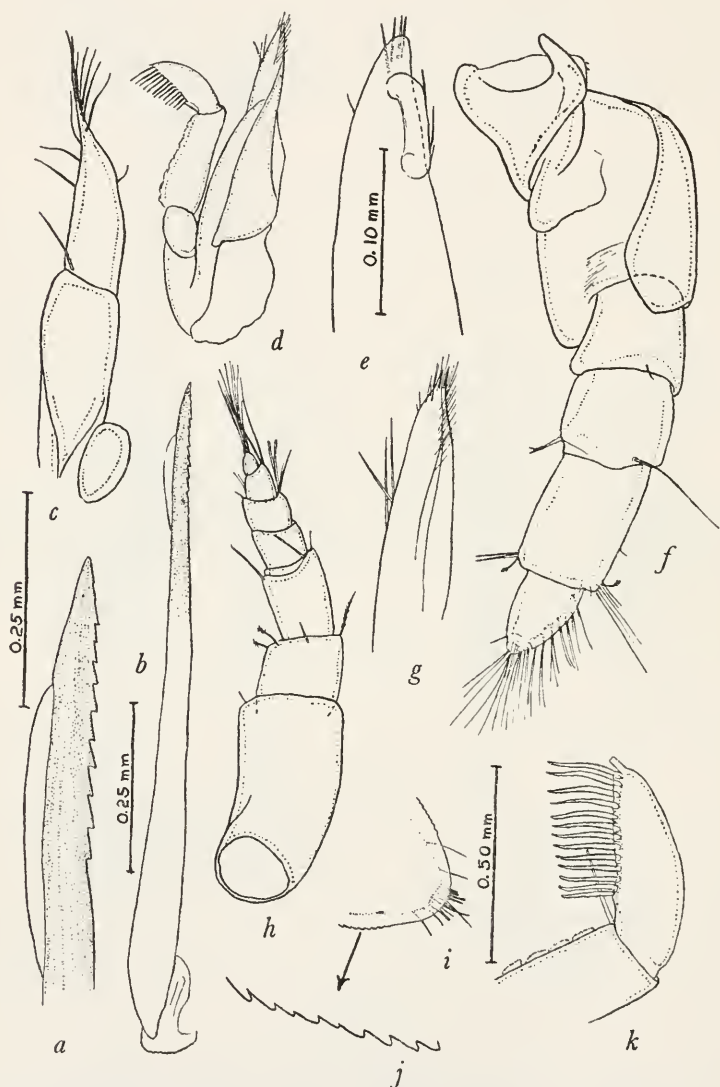


FIGURE 10.—*Paranthura elegans*, new species: *a*, Tip of first maxilla, female paratype; *b*, maxilla, female paratype; *c*, left maxilliped, female paratype; *d*, mandible, female paratype; *e*, tip of stylus of second male pleopod, paratype; *f*, second antenna, holotype; *g*, lower lip (?), female paratype; *h*, first antenna, holotype; *i*, posterior tip of telson, holotype; *j*, posterolateral border of telson, holotype; *k*, terminal joint of mandibular palp, female paratype. (Magnification as indicated by scales: *g* and *k* same as *a*; *c*, *d*, *f*, *h*, and *j* same as *b*.)

*Maxilliped*.—With two free joints, last joint tapering to a very narrow tip.

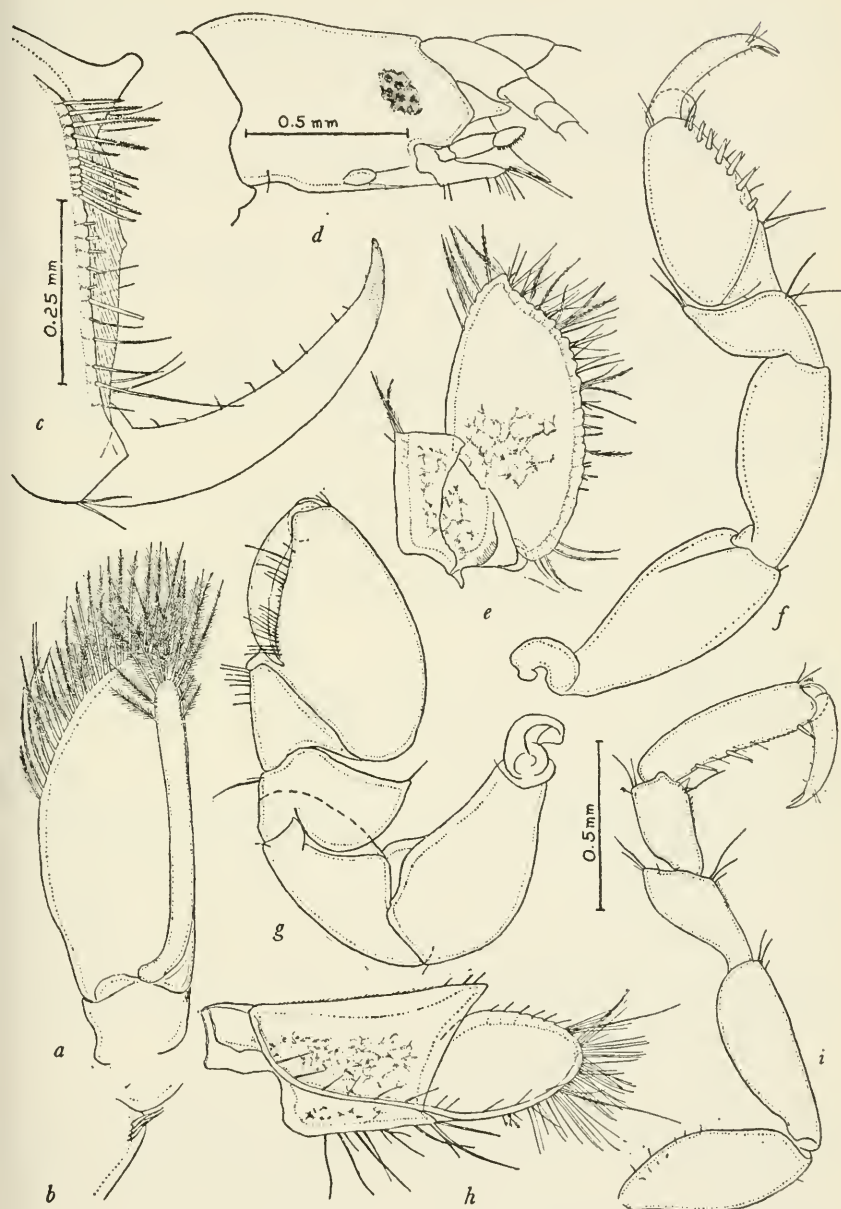


FIGURE 11.—*Paranthura elegans*, new species: *a*, First pleopod, holotype; *b*, spinelike setae on inner margin of basal segment of first pleopod, holotype; *c*, first peraeopod, distal joints, holotype; *d*, lateral view of cephalon, holotype; *e*, exopodite of uropod, dorsal surface; *f*, second peraeopod, holotype; *g*, first peraeopod, holotype; *h*, endopodite of uropod, dorsal surface; *i*, seventh peraeopod, holotype. (Magnification as indicated by scales: *e-i* same as *a*; *c* same as *b*.)

*First maxilla*.—Outer lobe with about twelve sawlike teeth.

*Second maxilla*.—Coalesced with lower lip, distally setiferous.

*Mandible*.—Apex acute and setiferous. Palp with three joints, the second the longest and bearing about eight pectinate scales on inner border and a single seta at distal end on inner border; last joint with a row of 14 setae on inner border.

*Peraeopods*.—See figure 11, *c, f, g, i*. Propodus of gnathopod with about 11 toothed setae on inferior margin near proximal end.

*Uropods*.—Endopodite exceeding telson length. Exopodite with posterolateral border slightly sinuate.

*Second male pleopod*.—Stylus with a setiferous cylindroid lobe near tip; apex with four fine setae.

*Types*.—Holotype, allotype, and 2 female and 2 juvenile paratypes collected at the type locality, Tomales Bluff (reef), Tomales Point, Marin County, Calif., June 9, 1948, by R. J. Menzies; washed with formalin from holdfast of the alga *Laminaria*. Type material has been deposited as follows:

United States National Museum, holotype female, No. 87692; allotype, No. 87693; 4 female and 4 juvenile paratypes, Nos. 87694–87696. Allan Hancock Foundation, 1 male, 2 female, and 2 juvenile paratypes. Pacific Marine Station, 2 male, 3 female, and 3 juvenile paratypes, accession Nos. 1244–1248 Arth.

*Geographical distribution*.—California, from Marin County to San Diego County.

*Material examined*.—Specimens were examined that had been collected from the following California localities:

MARIN COUNTY: *Tomales Point*, Tomales Bluff, reef, June 9, 1948 (R. J. M.), holotype, allotype, and four paratypes; ocean side, November 28, 1947 (R. J. M.), 1 juvenile; May 23, 1948 (R. J. M.), 1 female; bay side, November 28, 1947 (R. J. M.), 1 male, 1 female; May 23, 1948 (R. J. M.), 3 males, 3 ovigerous females, 6 juveniles. SAN MATEO COUNTY: *Moss Beach*, December 26, 1947 (Margaret Barr), 1 female. MONTEREY COUNTY: *Hopkins Marine Station*, July 23, 1947 (Robert W. Storer), 1 female. SAN DIEGO COUNTY: *La Jolla, Childrens Cove*, June 9, 1947 (R. J. M.), 1 female.

*Ecology*.—Specimens were collected most frequently from the lowest exposed areas of the exposed rocky coast localities. They were found on the algal holdfasts of *Macrocystis* and *Laminaria*, among coralline algae, and on the dorsal surface of the abalone *Haliotis* sp. One specimen was found in a membranous tube attached to branchings of a coralline alga, *Bossea* sp.

*Remarks*.—The description of the species *Edanthura linearis* Boone (1923, pp. 148–149) is hardly more than generic, and although it is easy to recognize that *Edanthura* is a synonym of *Paranthura* it is impossible to distinguish the species from the known species of *Par-*



*anthura*. I therefore consider *Edanthura linearis* a nomen nudum.

Small and juvenile specimens of *Paranthura elegans* differ from adult specimens in having very small and weakly developed seventh peraeopods and sixth peraeopod propodal joints beset with one less 2-pointed seta on the inferior margins.

Genus **CYATHURA** Norman and Stebbing, 1886

**CYATHURA MUNDA**, new species

FIGURES 12, 13

*Holotype*.—Male, length 5.2 mm., width at widest part of second peraeon somite 0.5 mm.

*Allotype*.—Ovigerous female, length 6.0 mm., width 0.4 mm.

*Diagnosis*.—Rostral projection equaling forward extent of cephalic anterolateral angles. Eyes small, number of ocelli not discerned. Uropodal endopodite not extending beyond telson posterior margin; exopodite posterolateral margin sinuate. Tip of stylus of male second pleopod simple, lacking lobes and setae. Telson posterior border concave, lateral borders smooth. Paired statocysts in anterior part of telson. Maxilliped with three free joints.

*Character of body*.—Length exceeding nine times the width. Color white with scattered clumps of black chromatophores, color pattern distinctive.

*Cephalon*.—Eyes small, number of ocelli not discerned. Rostral projection bluntly angulate, equaling the forward extent of anterolateral angles. Ocular lobe in lateral view with apex anteriorly ventral to eye.

*Peraeon*.—First six somites similar in length. Seventh somite slightly shorter than sixth. Second and third somites each with an anterior dorsal depression for reception of the posterior border of first and second somites, respectively. No keels, ridges, or pits evident.

*Pleon*.—The segmentation of the first five somites, although visible laterally, is not discernible dorsally. Sixth somite with a pronounced dorsal medial cleft on the line which separates that somite from the telson. Telson dorsally slightly swollen; lateral borders smooth, posterior margin concave; paired statocysts present in anterior end.

*First antenna*.—Peduncle composed of three joints. In male, flagellum brushlike, composed of four short setiferous joints; in female flagellum composed of a single joint having a setiferous knob at tip, which perhaps represents another joint.

*Second antenna*.—Peduncle composed of six segments. Flagellum with a single, tapering, setiferous joint, which is slightly longer than one-half the length of the last peduncular joint.

*Maxilliped*.—Composed of three wide free joints.

*First maxilla*.—Outer lobe with six marginal fingerlike teeth.

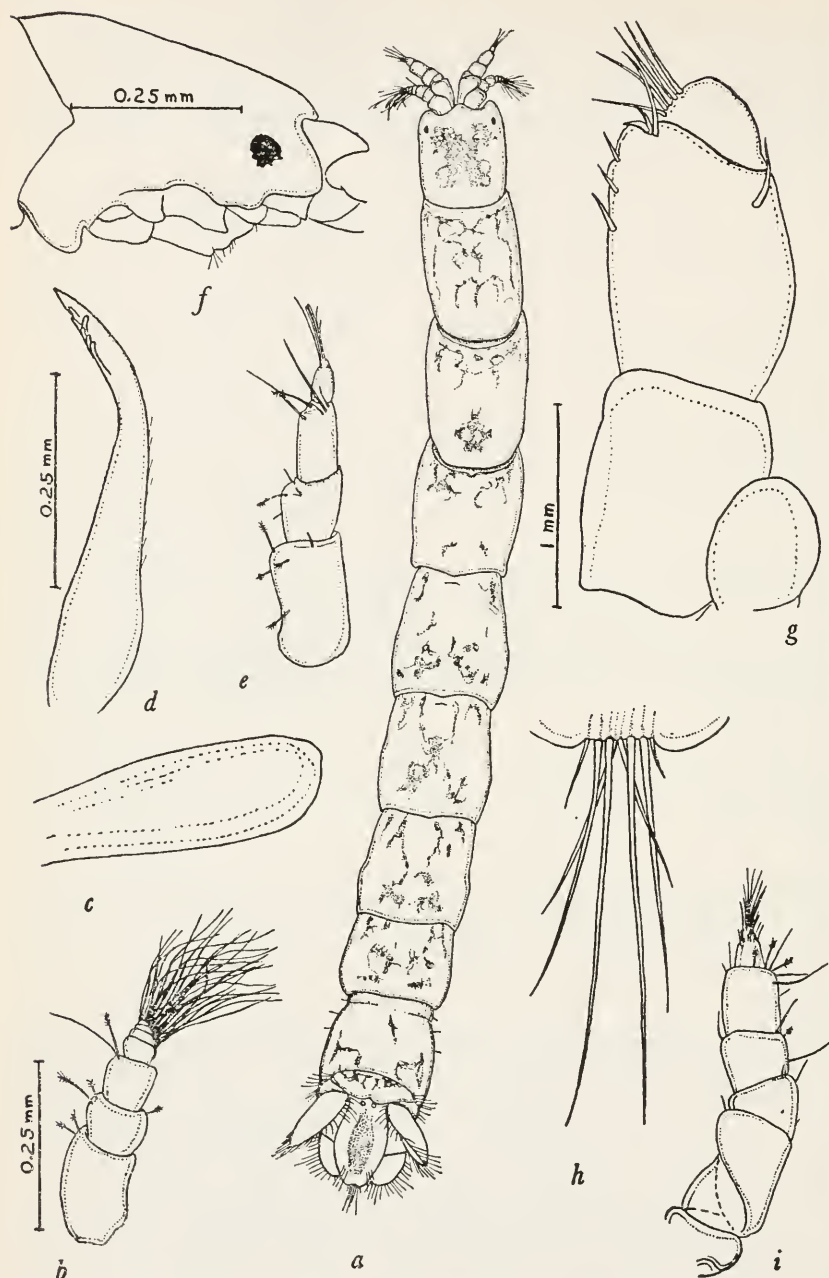


FIGURE 12.—*Cyathura munda*, new species: *a*, Holotype male; *b*, first antenna, holotype; *c*, tip of stylus of male second pleopod, holotype; *d*, first maxilla, right; *e*, first antenna, right, female paratype; *f*, lateral view of cephalon, holotype; *g*, maxilliped, left, female paratype; *h*, tip of telson, holotype; *i*, second antenna, holotype. (Magnification as indicated by scales: *e* and *i* same as *b*; *d*, *g*, and *h* same as *c*.)

*Mandible*.—Left and right mandibles similar. Incisor process with five small teeth. A thin flange having five teeth located proximal to incisor. Molar process short and blunt. Palp with three joints, last

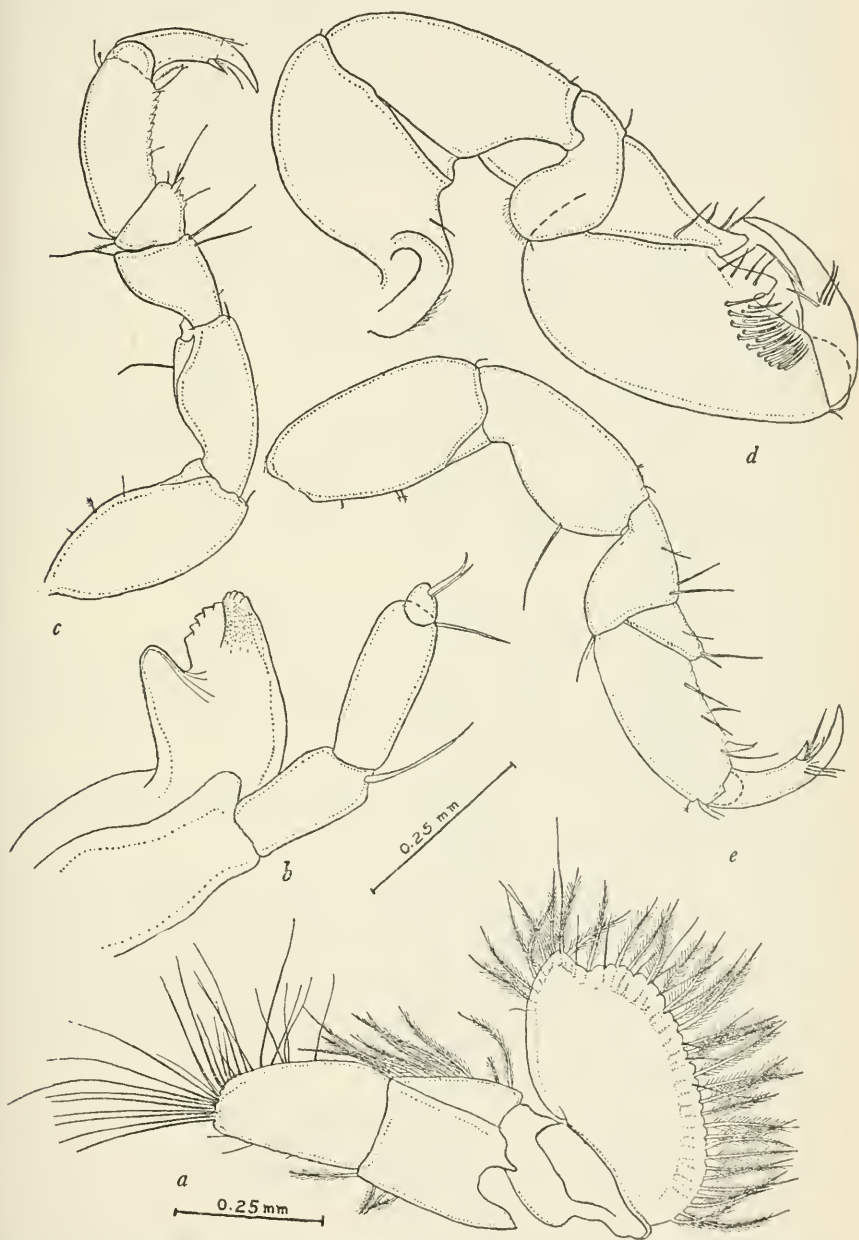


FIGURE 13.—*Cyathura munda*, new species: *a*, Uropod, dorsal view, holotype; *b*, right mandible, paratype; *c*, sixth pereopod; *d*, first pereopod; *e*, second pereopod. (Magnification as indicated in scales; *c-e* same as *a*.)

joint about one-fourth the length of second and longest joint. Terminal joint with two setae at apex.

*Peraeopods*.—See figure 13, *c-e*. Gnathopod typical, bearing a large tooth on inferior propodal margin and seven rows of three setae on inner surface near anterior end of propodus; anterior carpal tooth as large as propodal tooth.

*Uropod*.—Endopodite not exceeding telson length. Exopodite widened distally and having a sinuate posterolateral margin.

*Second male pleopod*.—Stylus with a simple apex with no lobes or setae.

*Types*.—Holotype, allotype, and 2 male, 3 female, and 1 juvenile paratypes collected at the type locality, Tomales Bluff (reef), Tomales Point, Marin County, Calif., June 9, 1948, by R. J. Menzies; washed with formalin from the holdfast of the alga *Laminaria*. Type material has been deposited as follows:

United States National Museum, holotype male, No. 87706; allotype, No. 87707; 1 male, 1 female, and 2 juvenile paratypes, Nos. 87708–87709. Allan Hancock Foundation, 2 juvenile paratypes. Pacific Marine Station, 2 female paratypes, accession No. 1250 Arth.

*Geographical distribution*.—California, from Marin County to Monterey County.

*Material examined*.—Specimens were examined that had been collected from the following California localities:

MARIN COUNTY: *Tomales Point*, Tomales Bluff, reef, June 9, 1948 (R. J. M.), holotype, allotype, and 6 paratypes; bay side, May 23, 1948 (R. J. M.), 2 juveniles. MONTEREY COUNTY: *Point Pinos*, July 3, 1947 (L. Kellen), 1 juvenile.

*Ecology*.—Specimens were collected from the lowest exposed areas of the exposed rocky coast localities. They were found on holdfasts of the algae *Egregia* and *Laminaria*.

*Remarks*.—This proposed new species differs from the known species of *Cyathura* in having small but well developed eyes, in lacking dorsal pits and dorsolateral keels, and in having the stylus of the second male pleopods simple in structure. Of the known species it appears to be most nearly related to *Cyathura crucis* Barnard. It differs from that species in having a more ovoid telson and a distinctly concave telsonic posterior border.

Genus COLANTHURA Richardson, 1902

COLANTHURA SQUAMOSISSIMA, new species

FIGURES 14–16

*Holotype*.—Male, length 4.5 mm., width at widest part of second peraeon somite 0.4 mm.

*Allotype*.—Ovigerous female, length 5.2 mm., width 0.5 mm.



*Diagnosis.*—Rostral process very slightly exceeding forward extent of anterolateral angles. Eyes large, composed of about 14 ocelli. Endopodite of uropod extending to or very slightly beyond telson tip; exopodite not so long as telson, being narrow and pointed at tip. Tip of stylus of male second pleopod with a simple, swollen, non-setiferous tip. Lateral pleotelson borders smooth; posterior border widely convex. Seventh peraeon somite narrower and shorter than first pleon somite. Seventh pair of peraeopods lacking. No statocysts observed. Maxilliped with one free joint.

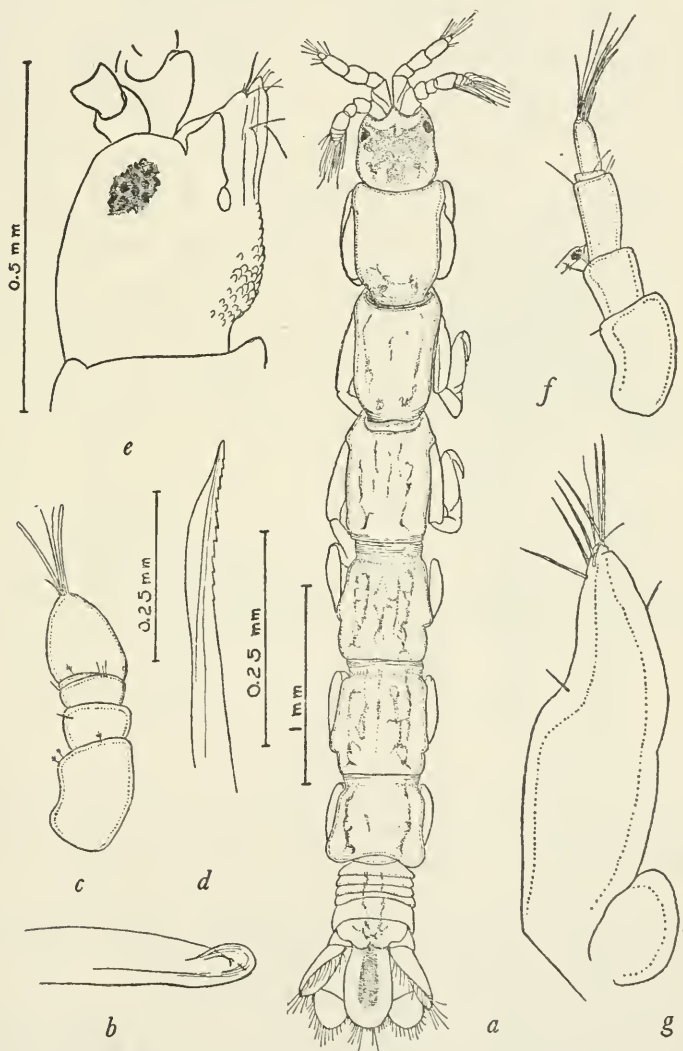


FIGURE 14.—*Colanthurus squamosissima*, new species: a, Holotype, male; b, tip of stylus of second male pleopod; c, first antenna, young male paratype; d, first maxilla, holotype; e, lateral view of cephalon, holotype; f, first antenna, allotype; g, maxilliped, left, holotype. (Magnification as indicated by scales: d and g same as b; f same as c.)

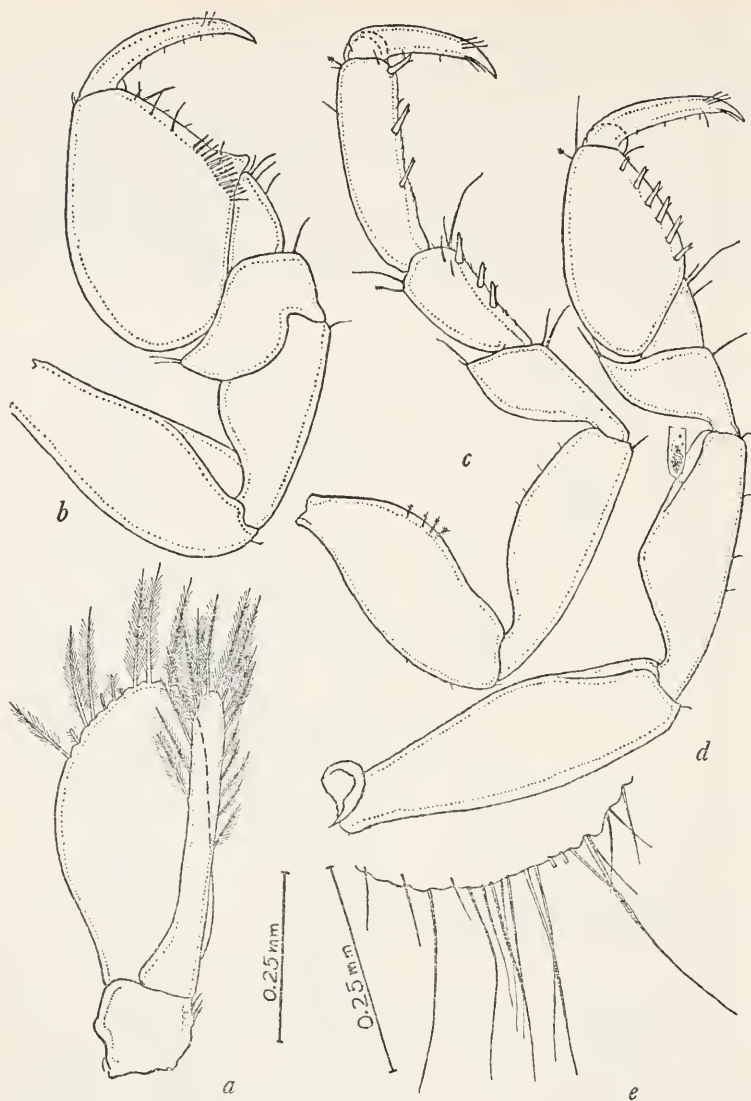


FIGURE 15.—*Colanthura squamosissima*, new species: *a*, First pleopod, male; *b*, first peraeopod, holotype; *c*, sixth peraeopod, holotype; *d*, second peraeopod, holotype; *e*, tip of telson, holotype. (Magnification as indicated by scales: *b*–*d* same as *a*.)

*Character of body*.—Body length exceeding nine times the width. Body dull gray, having a heavily pigmented cephalon and longitudinal lines of black pigment on most peraeon somites.

*Cephalon*.—Rostral process very slightly exceeding forward extent of anterolateral angle. Eyes large, longitudinally ovate, with about 14 ocelli. Ocular lobe in lateral view with a very slightly produced

blunt apex. Ventral surface of cephalon posterior to oral area covered with conspicuous large scales.

*Peraeon*.—First five somites similar in size. Sixth somite shorter than fifth. Seventh somite one-seventh the length of sixth somite and having only a crescentic dorsal area visible in dorsal view behind the sixth somite. Second and third somites with an anterior dorsal concavity for the reception of the posterior borders of the first and second somites respectively.

*Pleon*.—Demarcation of somites visible dorsally. First four somites similar, the first slightly longer than the others. Fifth somite about four times the length of fourth. Sixth somite firmly fused with telson, having a dorsal median posterior concavity indicating the line of fusion. Telson spatulate, apex evenly convex with a finely crenulate margin, lateral borders smooth.

*First antenna*.—Peduncle composed of four segments; fourth segment very small, only partially separated from third. Flagellum in adult male composed of a large basal joint followed by a brushlike series of five wide joints; in juvenile male, flagellum composed of a single large ovoid joint; in female, flagellum consists of an elongate basal joint having one or two minute joints at tip.

*Second antenna*.—Peduncle composed of six joints. Flagellum consisting of a single setiferous joint, which is about one-fourth the length of the sixth peduncular joint and considerably narrower than that joint.

*Maxilliped*.—Composed of a large free joint which possibly possesses a minute terminal joint.

*First maxilla*.—Outer lobe with about 12 marginal sawlike teeth.

*Mandible*.—Reduced, partially fused with cephalon. Palp, lacina, incisor, and molar process lacking. A thin transparent knifelike lobe is present on inner margin.

*Peraeopods*.—See figure 15, *b-d*. Gnathopod similar to that figured for *Paranthura elegans* except that the striated membranous lobe of the inferior propodal margin is lacking and the setal armature is different. Inferior propodal margin of second peraeopod with six 2-pointed setae.

*Uropod*.—Endopodite scarcely exceeding telson length. Exopodite narrow, with posterolateral margin not sinuate, apex pointed.

*Second male pleopod*.—Apex of stylus with a swollen nonsetiferous lobe.

*Types*.—Holotype, allotype, and 6 male, 6 female, and 2 juvenile paratypes collected at the type locality, Tomales Bluff (bay side), Tomales Point, Marin County, Calif., May 23, 1948, by R. J. Menzies; washed with formalin from the holdfast of the alga *Macrocystis*. Type material has been deposited as follows:

United States National Museum, holotype male, No. 87712; allotype, No. 87713; 2 male and 1 female paratypes, No. 87714. Allan Hancock Foundation, 2 male and 2 female paratypes. Pacific Marine Station, 2 male, 4 female, and 1 juvenile paratypes, accession No. 1243 Arth.

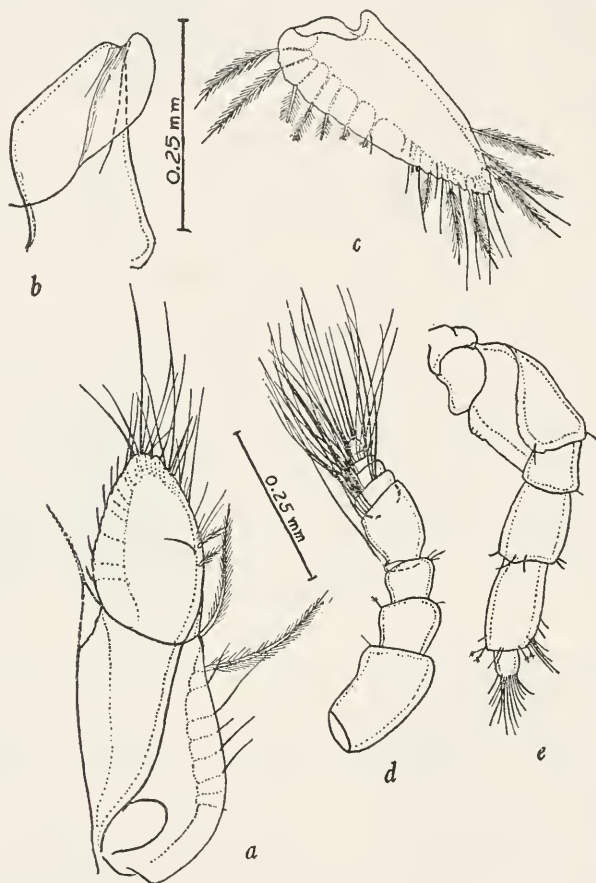


FIGURE 16.—*Colanthurus squamosissimus*, new species: *a*, Endopodite of uropod, dorsal view, holotype; *b*, mandible, male paratype; *c*, exopodite of uropod, dorsal view, holotype; *d*, first antenna, holotype; *e*, second antenna, holotype. (Magnification as indicated by scales: *c-e* same as *a*.)

*Geographical distribution*.—Known only from the type locality.

*Material examined*.—The above-listed types only.

*Remarks*.—This proposed new species differs from the only other known species, *Colanthurus tenuis* Richardson, in having a last peraeon somite, which is shorter than the first pleon somite and a pronounced pointed projection at the inner proximal angle of the propodal joint of the gnathopod. In *C. tenuis* the seventh peraeon somite is longer than the first pleon somite, and no projection is evident on the propodal joint of the gnathopod.



## Family ASTACILLIDAE

Only one species of this family, *Astacilla californica* Boone (1918, pp. 600-601, pl. 89, fig. 1), has been previously reported from California. Boone's species was collected at Venice, Calif., and is based on a single adult female. The new species described herein was collected by Joel W. Hedgpeth, and it is with considerable pleasure that I name it after a man who has contributed so much to the study of marine science in America. The species appears to be rare, at least intertidally, in that a prior year of collecting failed to yield a single specimen. As far as I know this is the first record of an *Idarcturus* species from the Northern Hemisphere.

## Genus IDARCTURUS Barnard, 1914

## IDARCTURUS HEDGPETHI, new species

FIGURES 17, 18

*Holotype*.—Ovigerous female, length 1.4 mm., width at widest part of second peraeon somite 0.9 mm.

*Diagnosis*.—Eyes lateral and bulging. Cephalon with two large spines on dorsum above eyes. First peraeon somite fused with cephalon, line of fusion indicated dorsally by a shallow transverse groove. Peraeon somites 1 to 7 with large triangulate anterolateral extensions, those of somites 6 and 7 appearing more lateral than anterolateral; somites 4 to 6 with large acute posterolateral spines; dorsal surface of posterior areas of somites 2 to 7 with a transverse row of four huge spines. Pleotelson composed of a single somite; each lateral margin with two large, angulate spines; posterior margin produced, apex blunt; dorsal surface near anterior end with two large, dorsally directed spines. Spinellike epimeral plates present on somites 3 and 4, those of somite 4 visible in dorsal view. Palp of second antenna with a 3-jointed flagellum, last joint with a large terminal claw. Maxilliped with two coupling hooks; palp with five segments. First peraeopod concealed from lateral view by lateral extensions of cephalon and first peraeon somite; claw lacking on distal joint.

*Character of body*.—Animal elongate, cream colored, body with huge spines, eyes black.

*Cephalon*.—Eyes bulging laterally. Anterior border deeply concave, with a minute median projection. Dorsal surface above eyes with two large laterally compressed spines. Lateral extensions of united cephalon and first peraeon somite conceal mouth parts and first peraeopod from lateral view.

*Peraeon*.—First somite fused with cephalon, line of fusion indicated dorsally by a shallow transverse groove, each anterolateral

angle with a large laterally directed spine. Second and third somites similar, each with triangulate anterolateral extensions and a transverse row of four large spines on dorsal surface. Fourth somite exceeding two times the length of third, having spination of third somite plus a single small spine on middorsal surface at posterior border; epimeral spine visible in dorsal view below anterolateral spine. Fifth and sixth somites similar to but narrower than third

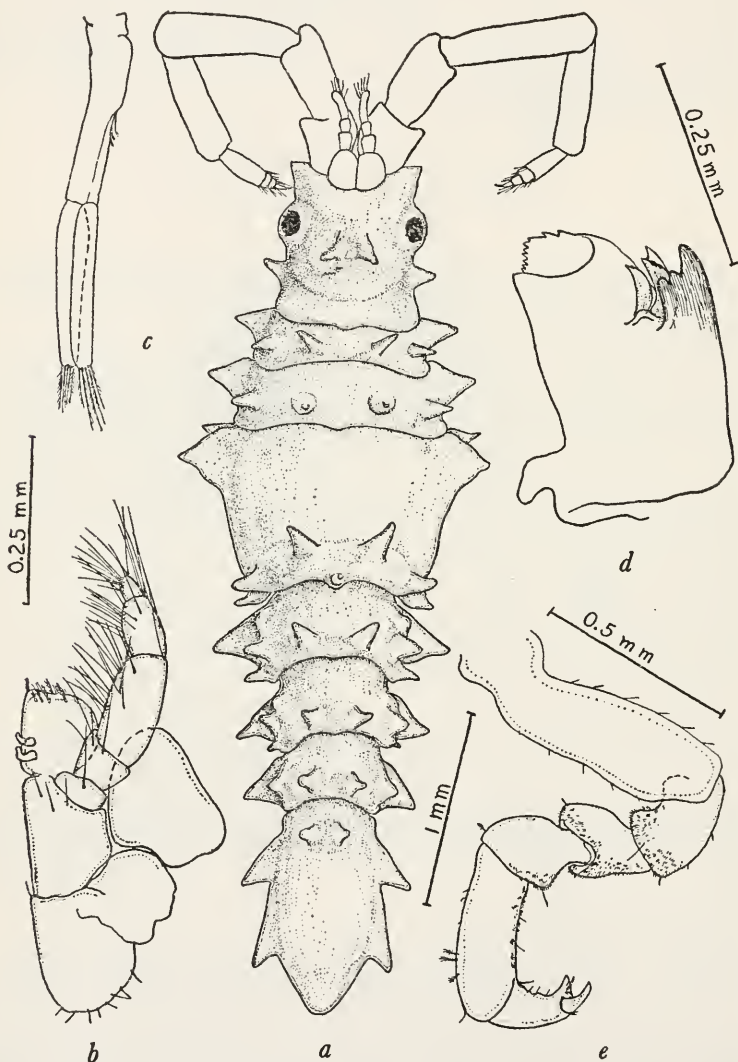


FIGURE 17.—*Idarcturus hedgpethi*, new species: *a*, Dorsal view, holotype; *b*, maxilliped; *c*, first pleopod, magnification not known; *d*, right mandible; *e*, fifth pereopod. (Magnification as indicated by scales.)

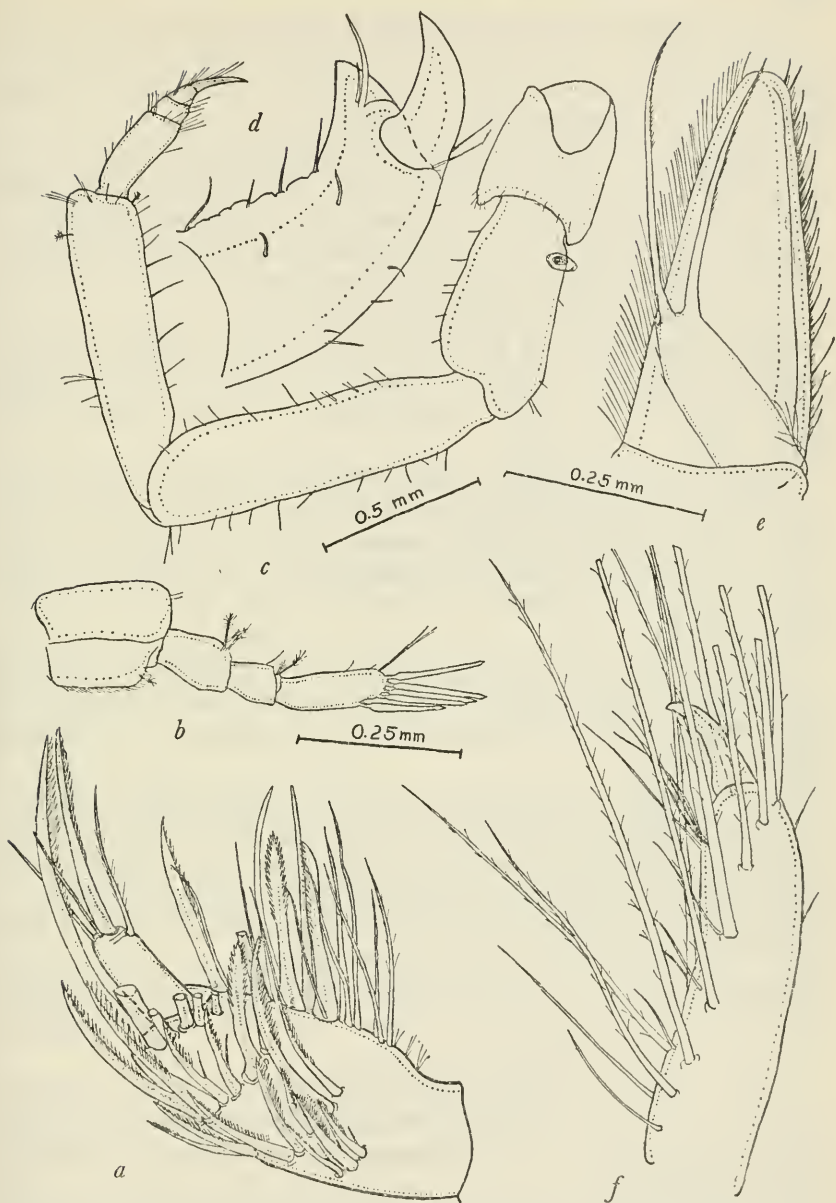


FIGURE 18.—*Idarcturus hedgpethi*, new species: *a*, Distal joints of first pereopod; *b*, first antenna; *c*, second antenna; *d*, distal joints of fifth pereopod; *e*, distal joints (rami of uropod, inner surface); *f*, distal joints of second pereopod. (Magnification as indicated by scales: *a*, *d*, and *f* same as *e*.)

and having a posterolateral spine and a lobe above lateral (antero-lateral) spine in addition to the spines present on third somite. Seventh somite similar to sixth but lacking the lobe and posterolateral spine of that somite.

*Pleon.*—Composed of a single somite. Each lateral border with two large, posterolaterally directed, angulate, projections; posterior border produced, apex blunt. Two large dorsally directed spines present on dorsal surface near anterior end.

*First antenna.*—Distal joint with few olfactory setae.

*Second antenna.*—All segments lacking spines or tubercles. Flagellum with three segments, last segment with a large apical claw.

*Maxilliped.*—With two coupling hooks, palp with five articles.

*First maxilla.*—Outer lobe with 11 apical setae. Inner lobe with three apical setae, two of which bifurcate at tip.

*Second maxilla.*—Each of the two outer lobe lappets with three ciliated setae at apex. Inner lobe apex with about nine small simple setae and two large ciliated setae, margin with three large ciliated setae.

*Mandible.*—Palp lacking. Left mandibular molar process with smooth, truncate cutting edge, incisor process with three teeth, lacina with two teeth, setal row with two setae. Right mandible incisor with three teeth, setal row with one large bidentate lacinoid seta and a smaller seta, molar process with inferior cutting edge finely serrate, lacina lacking.

*First peraeopod.*—Contained in buccal area, probably functions as a maxilliped. Distal segment lacking terminal claw, propodus with many serrate setae on medial surface, carpus with serrate setae on inferior margin.

*Second to fourth peraeopods.*—All similar, fourth largest; segments furnished with long ciliated setae, distal joint a simple claw.

*Fifth to seventh peraeopods.*—All ambulatory in structure; most segments with a fine pubescentlike covering of pectinate scales.

*Uropod.*—Concealed ramus with two long ciliated terminal setae which extend posteriorly to tip of exposed ramus.

*Marsupial plates.*—Four pairs present; those of second pair largest.

*Pleopods.*—First pleopods of female with five plumose setae at distal end of each distal branch.

*Types.*—Holotype (U.S.N.M. No. 87477) and paratype (U.S.N.M. No. 87478) collected at Tomales Bluff, Tomales Point, Marin County, Calif., south of reef, laminarian zone, on hydroid, August 5, 1948, by Joel W. Hedgpeth.

*Geographical distribution.*—Known only from the type locality.

*Material examined.*—Holotype and 1 female paratype.

*Remarks.*—This species differs from *Idarcturus platysoma*, Barnard, the genotype of *Idarcturus*, in having large body spines, which the genotype lacks.



## Family PARASELLIDAE

## Group IANIRINI Hansen, 1916

The group Ianirini is represented in northern California by a number of genera. This report includes only the species belonging to a new genus *Janiralata*, although remarks are necessary concerning certain related genera.

Many of the northern California representatives of the group Ianirini were previously placed in the genus *Iolella* Richardson. Although I consider *Iolella*<sup>1</sup> a valid genus, so far as I know it is not represented on the Pacific coast of North America. The records of species of *Janira* (auct. *Ianira*) from the Pacific coast of North America and Canada are also subject to question. The species recorded as *Janira occidentalis* Walker by Richardson (1905b, p. 472 and synonyms), Stafford (1913, pp. 183–185), and Hatch (1947, p. 172) belong in the new genus described in this paper. The specimens reported by Hatch (1947, p. 171) as the European species *Janira maculosa* Leach have been personally examined and in my opinion belong in the genus *Ianiropsis* G. O. Sars. The same is probably true of specimens reported by Fee (1926, p. 21) as *Janira maculosa* Leach, although I have not seen Fee's specimens. As yet I have seen no representatives of the genera *Iolella* or *Janira*, and I consider the Pacific coast species referred to those genera, by earlier writers, as belonging in the genus *Janiralata*.

Owing to the inadequacies of the descriptions of many of the described species it has naturally been impossible for me to assign with certainty all the species herein referred to *Janiralata*. Certain species have doubtfully been placed in *Janiralata* because they seem to fit the diagnosis of that genus better than that of any other genus with which I am acquainted.

A key to the species here assigned to *Janiralata* appears on pp. 137–138.

## JANIRALATA, new genus

*Genotype*.—*Janiralata davisi*, new species.

*Generic diagnosis*.—Janiridae in which the first, second, and third segments of the maxilliped palp are as wide as the endognath. Maxilliped with two or three coupling hooks. Dorsal surface of body lacking lobes or spinelike lobes. Epimera<sup>2</sup> distinct on somites 2–7 and visible in dorsal view. Eyes present, dorsal but near lateral margins. Second antenna with a conspicuous antennal scale. First male pleopods with tips laterally expanded as in *Ianiropsis*, but

<sup>1</sup> See "Remarks Concerning Hansen's Concept of *Janira* Leach" on p. 138 of this paper.

<sup>2</sup> Those of first peraeon somite frequently indistinct.

bearing a setiferous projection on distal margin near medial border of each sympodite. Second male pleopod with a styliform proximal endopodite branch and a lamellar, somewhat rectangular, exopodite whose caudal end is blunt and setiferous. Uropods 2-branched, exceeding one-half the pleotelson length; inner branch as long as or longer than the outer branch. Female operculum widely ovate, with a small median concavity on posterior border. Mandibular molar process with an expanded, truncated, toothed, setiferous tip; palp 3-jointed and bearing on distal third of second joint along medial margin two large denticulate setae and a diagonal row of similar but smaller setae on outer surface; last mandibular palp segment very much twisted at tip. Inferior border of proximal third of first peraeopod propodus with a number of subequal serrations. Carpal joint of first peraeopod swollen and beset with many 2-pointed setae on inferior margin; dactylus with two claws. Dactyls of other peraeopods with three claws. Pleon composed of a short anterior segment and a wide shieldlike pleotelson.

This genus appears to be intermediate between *Iolella* and *Ianiropsis*. It resembles *Ianiropsis* in having dorsally visible epimeral plates on peraeon somites 2-7. It resembles *Iolella* in that most of the species have the lateral peraeon margins produced into lappets. It differs from both genera in having a series of serrations on the inferior border of the proximal third of the propodus of the first peraeopod and in having a row of small denticulate setae between two large setae on the distal third of the second joint of the mandibular palp.

The generic characteristics given in the above generic diagnosis are omitted from the specific descriptions given for the new species described in this paper.

JANIRALATA DAVISI, new species

FIGURES 19, 20

*Holotype*.—Male, length 3.5 mm., width at widest part of second peraeon somite 2.0 mm.

*Allotype*.—Length 4.7 mm., width 2.4 mm.

*Diagnosis*.—Cephalon anterior border with a very short triangulate median lobe and two triangulate anterolateral expansions. Eyes dorsal, separated from lateral border a distance equal to their widths. Lobate lateral extensions of the first three peraeon somites separated from one another by a narrow V-shaped slit. Pleotelson posterior margin with rounded posterolateral areas and a short, rounded median lobe. Lateral areas of head and body setiferous. Maxilliped with three coupling hooks. First male pleopods with acute laterally ex-

panded tips; distal margins very slightly irregular except for the elevations that characterize the first male pleopods of species belonging to the genus.

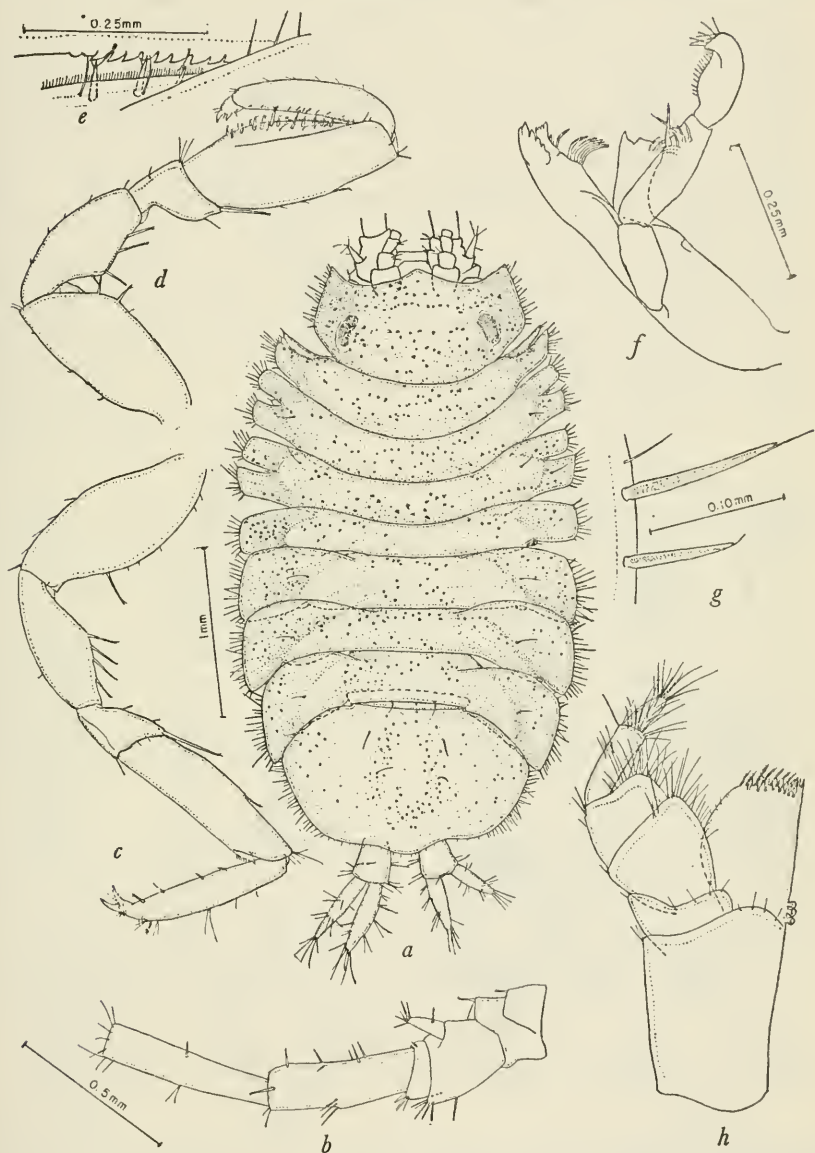


FIGURE 19.—*Janiralata davisi*, new species: *a*, Holotype, dorsal view; *b*, second antenna, paratype; *c*, seventh pereopod, left, holotype; *d*, first pereopod, left, holotype; *e*, proximal third of propodal inferior margin, first pereopod, holotype; *f*, mandible, left, paratype; *g*, setae of lateral border of cephalon, holotype; *h*, right maxilliped, holotype. (Magnification as indicated by scales: *c* and *d* same as *b*; *h* same as *f*.)

*Character of body.*—Lateral border of cephalon and body with a fringe of 2-pointed setae. Animal wide and flattened, having numerous, scattered, black chromatophores.

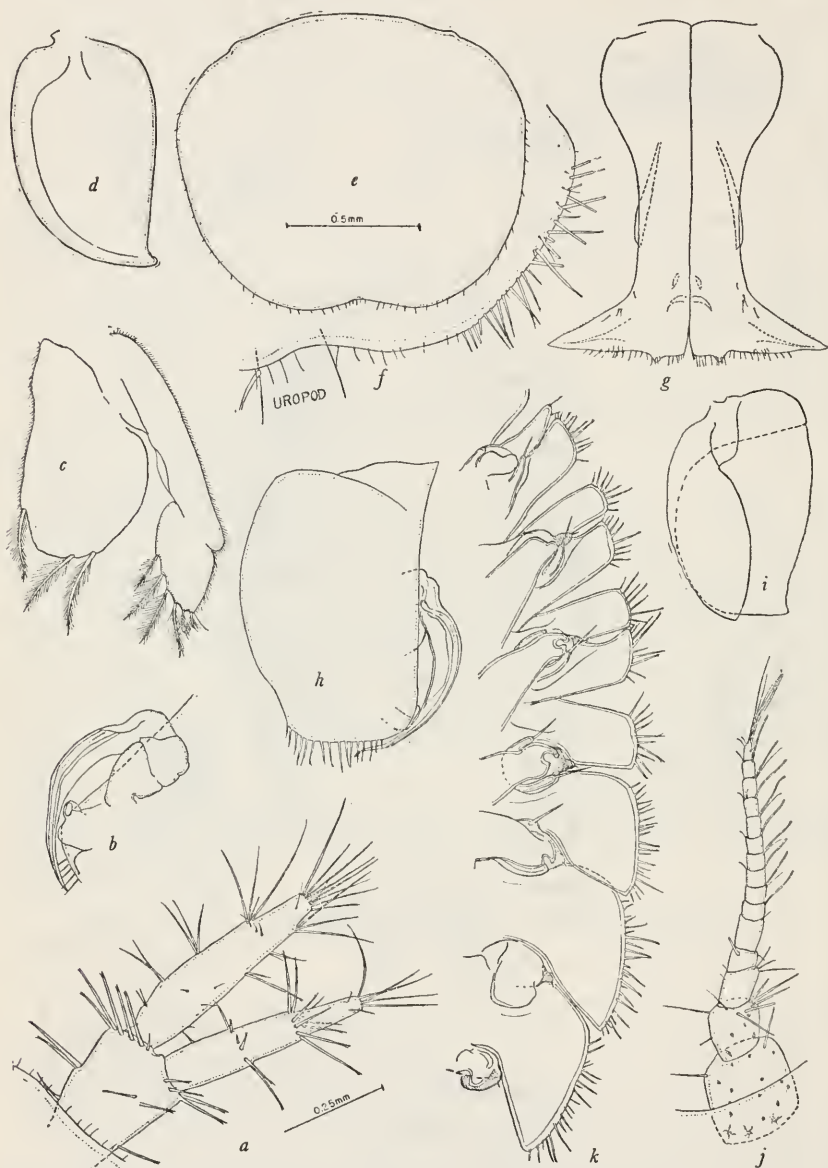


FIGURE 20.—*Janiralata davisi*, new species: *a*, Left uropod, holotype; *b*, inner view of right second male pleopod, paratype; *c*, right third pleopod, paratype male; *d*, right fifth pleopod, paratype male; *e*, female operaculum, allotype; *f*, pleotelson right border, holotype; *g*, first pleopods, paratype male; *h*, outer view of right second male pleopod, paratype; *i*, right fourth pleopod, paratype male; *j*, first antenna, holotype; *k*, right lateral border, ventral view of holotype, stippled areas of epimera visible in dorsal view. (Magnification as indicated by scales: *b-d* and *f-j* same as *a*; *k* same as *e*.)



*Cephalon*.—Wider than long, anteriorly with a very short triangulate median lobe and two triangulate anterolateral expansions. Eyes dorsal, separated from lateral border a distance equal to their widths.

*Peraeon*.—Anterior border of first somite slightly concave. Lateral portions of first, second, and third somites directed slightly anteriorly, the fourth laterally, fifth to seventh slightly posteriorly. First to third somites of similar length, fourth shortest, fifth to seventh longest. Lateral border of first somite bilobate, anterior lobe pointed; posterior lobe laterally truncate and is twice the length of anterior lobe. Lateral borders of second and third somites bilobate, lobes with truncate lateral borders. Anterior lateral lobe of first three somites separated from posterior lobe by a narrow V-shaped slit. Lateral border of fourth somite unilobate, lobe with truncate lateral border. Lateral borders of fifth to seventh somites similar, all having slightly convex lateral borders. Epimera visible in dorsal view between lobes of somites 2 and 3 and posterior and medial to the lateral expansions of somites 4 to 7. Dorsolateral surfaces of peraeon with very few setae.

*Pleon*.—Posterolateral pleotelson borders lacking sharp angles; posterior margin with a small median lobe. Lateral pleotelson border with numerous large, 2-pointed setae; posterior margin with scattered setae. Pleotelson dorsal surface with few setae.

*First antenna*.—Located on each side of rostral projection, composed of a 4-segmented peduncle and a flagellum having 11 segments. First peduncle article two times the length and width of second, third article narrower and only slightly shorter than second, fourth article about one-half the length of third. Last ten flagellar segments each with a long ribbonlike sensory filament on ventromedial border.

*Second antenna*.—About as long as body. Peduncle having six segments; first two segments subequal in length, third as long as both prior segments and bearing a large setiferous scale on lateral margin, fourth segment about one-half the length of third, fifth and sixth segments subequal in length, each exceeding about two times the length of third segment. Flagellum about twice the length of peduncle and composed of about 54 segments.

*Maxilliped*.—With three coupling hooks.

*First maxilla*.—Very similar to that figured for *Janiralata rajata* (see fig. 22, e).

*Second maxilla*.—Each of the two outer lobe lappets with four denticulate apical setae. Inner lobe with about ten large setae and many fine setae on margin and apex.

*Mandible*.—Left mandible with incisive part having five teeth; lacina with four teeth; setal row with one seta at base of lacina and a row of six setae proximal to the solitary one; molar process with expanded, denticulate tip bearing six narrow setae; palp composed of

three articles, the second of which is the longest. Distal third of inner margin of second palp article with two long denticulate setae between which is an oblique row of three similar but smaller setae. Left mandible similar to right except that it lacks a lacina and bears 11 setae in setal row.

*First peraeopod*.—Propodus with a row of about 9 subequal serrations on proximal third of inferior margin. Carpus expanded, bearing 15 2-pointed setae along inferior margin.

*Other peraeopods*.—In general structure similar to first peraeopods except that the carpal segment is not expanded.

*Uropods*.—Not exceeding pleotelson length; each composed of a peduncle and two branches. Peduncular segment widest at distal end, branches subequal in length. In allotype the peduncular segment is about as long as inner branch and is more setose than that figured for holotype.

*Pleopods*.—First male pleopods with lateral distal angles acute, distal margins very slightly irregular save for the setiferous elevations that characterize species of this genus. Second male pleopod with outer branch somewhat rectangular, having a truncate, setiferous distal margin; inner branches with a curved, styliform proximal branch extending beyond the tip of outer branch and located midway between distal and proximal margins and a short thick distal branch articulating slightly proximal to the mediodistal angle of outer plate. Third male pleopod with a narrow 2-jointed exopodite, distal joint bearing six plumose setae; endopodite roughly rectangular, with three plumose setae on distal margin. Fourth male pleopod with fleshy single-jointed branches that lack setae.

*Types*.—Holotype, allotype, and 1 male and 5 female (1 ovigerous) paratypes collected at the type locality, Carmel Cove, Monterey County, Calif., July 6, 1947, by John Davis; specimens found on undersurface of submerged rock in zone 4 of the intertidal.<sup>3</sup> Type material deposited as follows:

United States National Museum, holotype, No. 87479; allotype, No. 87480; 1 male and 2 female paratypes, No. 87481. Allan Hancock Foundation, 1 female paratype. Pacific Marine Station, 2 female paratypes, accession No. 1218 Arth.

JANIRALATA RAJATA, new species

FIGURES 21, 22

*Holotype*.—Male, length 4.0 mm., width at widest part of second peraeon somite 1.0 mm.

*Diagnosis*.—Cephalon with an exceedingly short, evenly rounded

<sup>3</sup> Specimens donated to writer by Dr. Frank A. Pitelka, Zoology Department, University of California.

rostrum; anterolateral border evenly rounded, with two setae. Eyes large, almost touching lateral margins. Lateral lobate extensions of second and third peraeon somites separated from one another by a distance exceeding three times the length of largest lobe. Pleotelson

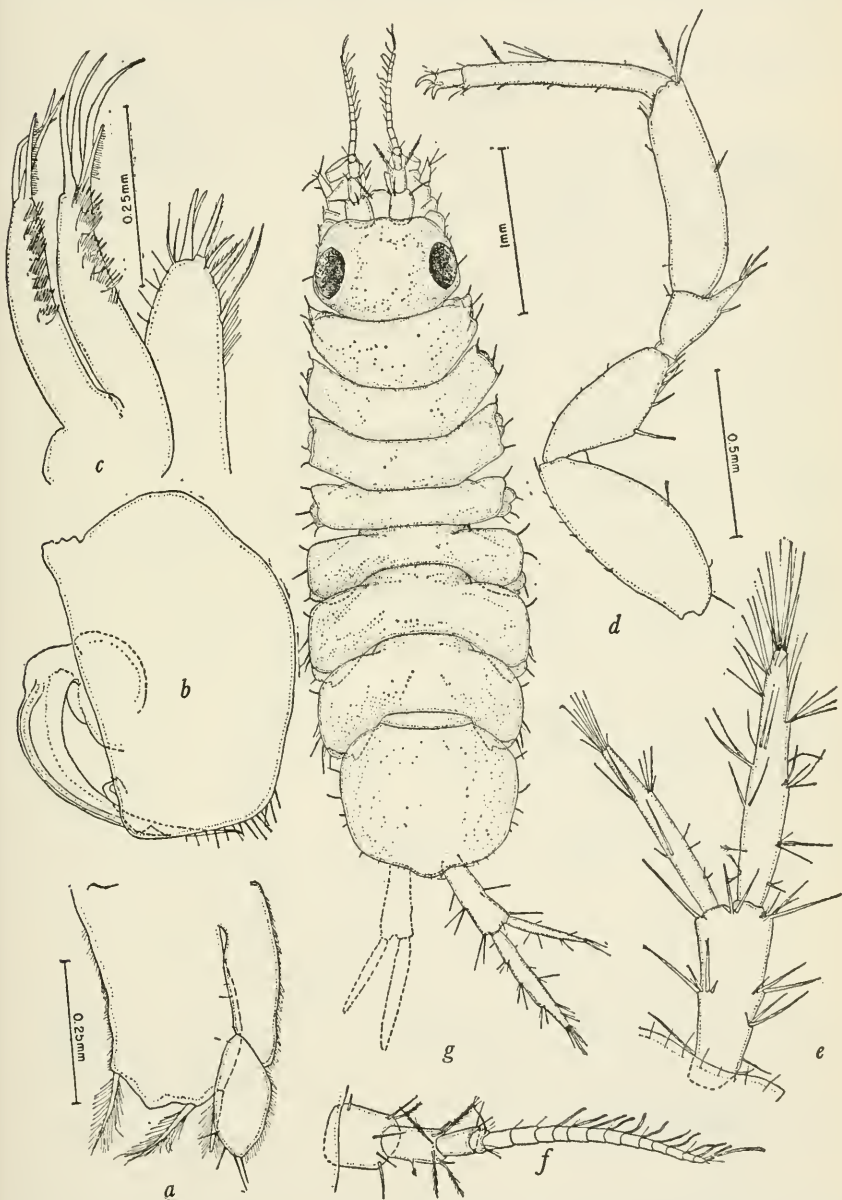


FIGURE 21.—*Janiralata rajata*, new species, holotype male: a, Third pleopod, left; b, second pleopod, left; c, second maxilla, right; d, sixth peraeopod, right; e, uropod, right; f, first antenna, right; g, holotype. (Magnification as indicated by scales: b same as a; e and f same as d.)

with posterolateral areas evenly rounded; posterior margin with a slight median convexity. Lateral cephalon areas each with a single seta; body and pleotelson with few setae on lateral borders. Lateral tip of each first male pleopod twisted to form a groove.

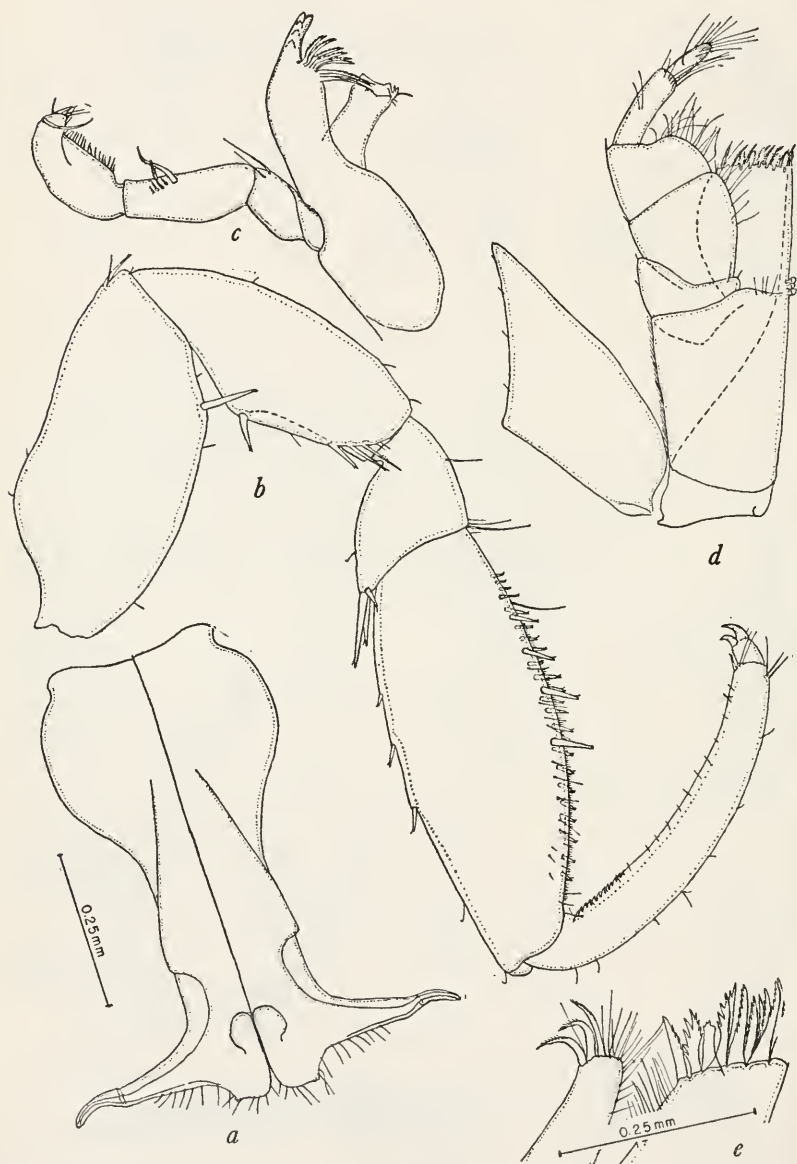


FIGURE 22.—*Janiralata rajata*, new species; holotype male: *a*, First pleopod, inner surface; *b*, first peraeopod, right; *c*, mandible, right; *d*, maxilliped, right; *e*, first maxilla, right. (Magnification as indicated by scales: *b-d* same as *a*.)



*Character of body.*—Body elongate, narrow, and flattened. Lateral borders of cephalon and body with few setae. White in color, no black chromatophores evident. Lateral peraeon areas not expanded into conspicuous lappets.

*Cephalon.*—About as long as wide. Frontal margin with a very slight median lobe; anterolateral angulate expansions lacking. Eyes very large, situated close to the lateral margins. A single large seta on lateral border opposite each eye.

*Peraeon.*—First somite with anterior border slightly concave. Lateral portions of first to third somites directed slightly anteriorly, fourth laterally, fifth to seventh slightly posteriorly. First somite longer than second, second equals length of third, fourth shortest, fifth slightly longer than fourth, sixth longer than fifth, seventh longer than sixth, being about twice the length of the fourth somite. Lateral borders first to third somites bilobed. Lateral border of fourth somite with a pronounced anterior lobe and a very weak posterior lobe. Lateral border of fifth to seventh somites expanded, slightly convex, lacking a pronounced posterolateral angle. Lateral lobate extensions of second and third peraeon somites separated from one another by a distance exceeding three times the length of largest lobe. Epimera bilobed and setiferous, visible in dorsal view on all peraeon somites.

*Pleon.*—Pleotelson slightly longer than wide. Lateral borders with few setae; median lobe of posterior margin small. Posterolateral areas evenly rounded, no evident angles formed. Dorsal surface without conspicuous setae.

*First antenna.*—Similar to that of *Janiralata davis*i (compare figs. 20, *j*, and 21, *f*) but having narrower peduncular joints. Flagellum composed of 13 joints. First and second peduncular joints with ciliated setae.

*Second antenna.*—Peduncle similar to that figured for *J. davis*i (see fig. 19, *b*), flagellum missing.

*Maxilliped.*—With three coupling hooks.

*First maxilla.*—Outer lobe with 12 denticulate setae. Inner lobe with three large setae and some narrow marginal setae.

*Second maxilla.*—Each of the two outer lobe lappets with four apical denticulate setae and a medial row of conspicuous pectinate scales. Inner lobe with seven large setae and a few smaller setae.

*Mandible.*—Left mandible incisor process with five teeth, lacina with four teeth, setal row with six setae, second joint of palp with four small denticulate setae in an oblique row between two larger marginal setae. Right mandible lacks lacina; has nine setae in setal row.

*First peracopod.*—Similar to that figured for *J. davis*i (compare figs. 19, *d*, and 22, *b*) except that the carpal inferior margin has 26 2-pointed setae.

*Uropods*.—Greatly exceed pleotelson length.

*Pleopods*.—Lateral tip of each first male pleopod twisted to form a groove. Second and third male pleopods very similar to those figured for *J. davis*i (compare figs. 20, *h, c*, with 21, *b, a*).

*Type*.—Holotype male (U. S. N. M. No. 43646) collected at Monterey Bay, Calif., date not given on label, by Harold Heath, from *Raja binoculata* egg, 20 fathoms.

*Geographical distribution*.—Known only from the type locality.

*Remarks*.—This specimen was identified by Dr. Harriet Richardson Searle as *Janiropsis californica* and was sent to me by Dr. Fenner A. Chace, Jr., curator of marine invertebrates, U. S. National Museum, as an example of that species. In my opinion this specimen could not possibly represent *Janiropsis californica*, inasmuch as the description applicable to this specimen differs much too greatly from the description of *Janiropsis californica* Richardson (Richardson, 1905b, p. 455, figs. 507–508). The types of *J. californica* are not to be found at the U. S. National Museum, according to Dr. Chace. There are some specimens in the Pacific Marine Station Museum collections that agree in most essential respects with the description and figures of *J. californica* as given by Dr. Richardson (*op. cit.*). The specimens were collected as ectocommensals from the isopod *Sphaeroma pentodon* Richardson and possibly belong in the genus *Iais*; however, I cannot agree with Dr. Th. Monod's supposition (Nordenstam, 1933, p. 179) that *Janiropsis californica* is a synonym of *Iais pubescens* (Dana).

#### JANIRALATA SOLASTERI (Hatch)

FIGURES 23, *e, f*; 24

*Janira solasteri* HATCH, 1947, p. 172, pl. 14, figs. 158–160.

*Diagnosis*.—Cephalon with an elongate, pointed rostrum; anterolateral borders each with a wide angulate projection. Eyes dorsal, situated a considerable distance away from the lateral borders of cephalon. Lateral lobate extensions of second and third peraeon somites separated from one another a distance exceeding twice the length of anterior lobe. Pleotelson with angulate, medially recurved posterolateral projections and a medially unilobate posterior margin that does not extend posteriorly beyond the limits of the posterolateral angles. Structure of male first pleopod not known.

#### SUPPLEMENTARY DESCRIPTIVE NOTES

*Cephalon*.—Wider than long, with a prominent pointed rostrum, two mediolateral lobes, and a setiferous angulate anterolateral extension on each side of cephalon. Eyes dorsal, bulging, located a considerable distance from lateral margins

*Peraeon*.—Similar to that figured for *J. occidentalis* (compare figs.

23, *a*, and 24, *a*), except that the epimeral lobe of the first somite is not visible in dorsal view between the lateral lobate extensions of that somite.

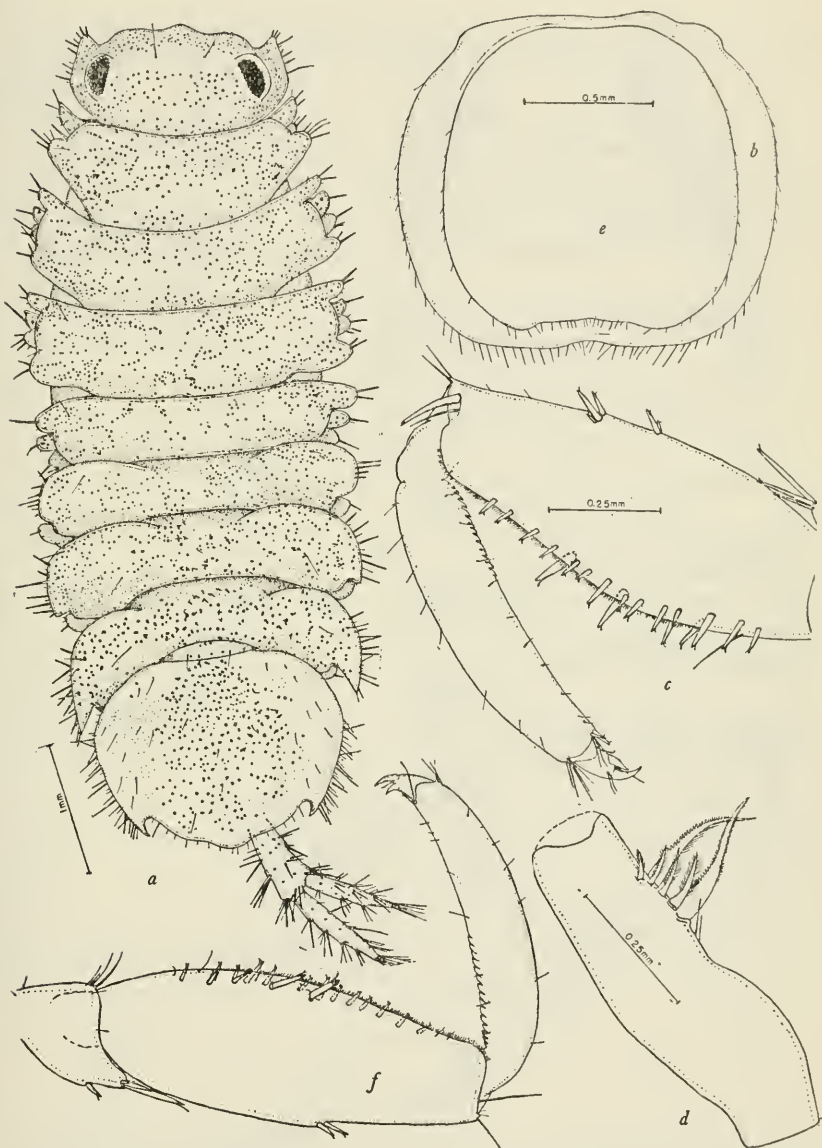


FIGURE 23.—*a-d*, *Janiralata occidentalis* (Walker): *a*, Ovigerous female hypotype; *b*, operculum, female hypotype; *c*, distal joints of first pereopod, female hypotype; *d*, second joint of mandibular palp of right mandible, female hypotype. *e, f*, *Janiralata solasteri* (Hatch), female paratype: *e*, operculum; *f*, distal joints of first pereopod. (Magnification as indicated by scales.)

*Pleotelson*.—Similar to that figured for *J. occidentalis* (compare figs. 23, *a*, and 24, *a*), except that the posterolateral spinelike projections are more pronounced and exceed very slightly the posterior ex-

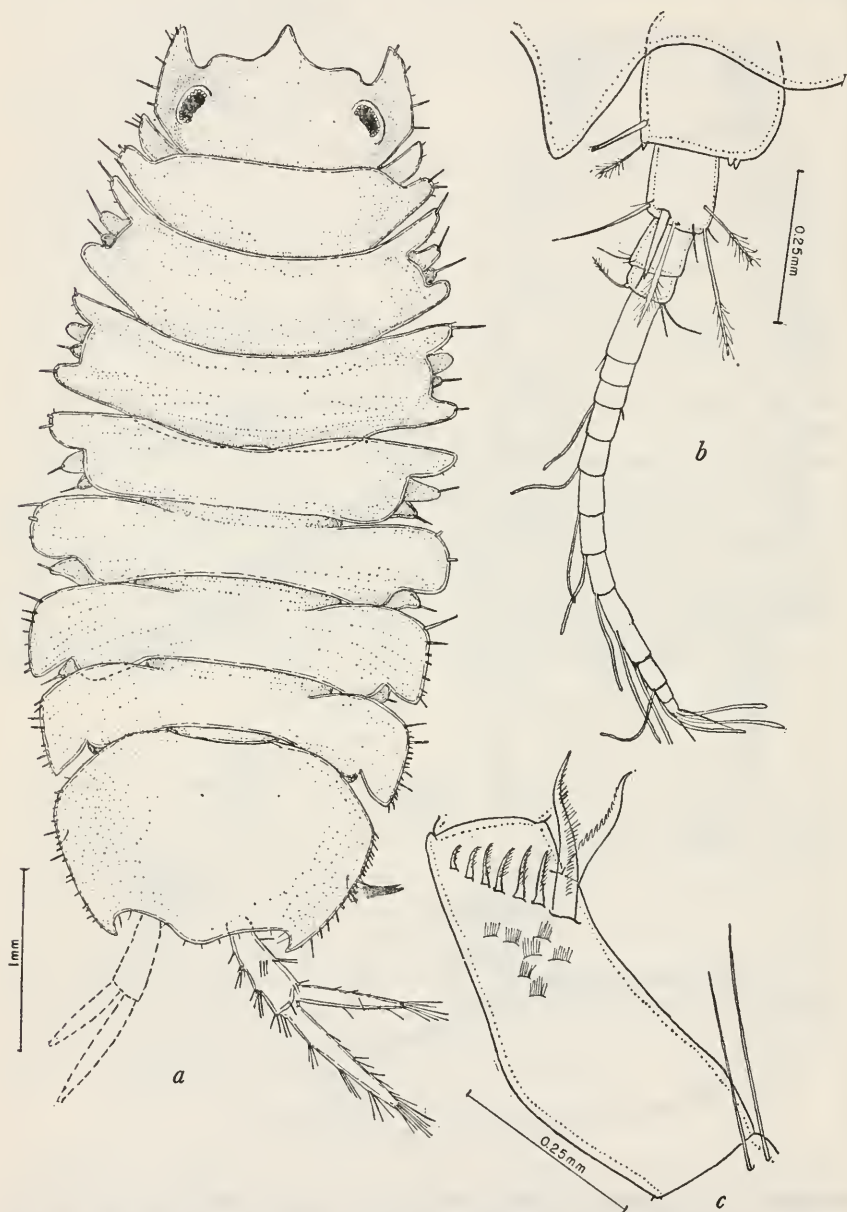


FIGURE 24.—*Janiralata solasteri* (Hatch): *a*, Female paratype; *b*, left first antenna, female paratype; *c*, second joint of mandibular palp of right mandible, female paratype. (Magnification as indicated by scales.)



tent of the median lobe of the posterior margin and that the posterior margin has concave lateral areas and a single convex median lobe.

*First antenna*.—Similar to that of *J. davisi* (compare figs. 19, *b*, and 24, *b*).

*Maxilliped*.—With two coupling hooks.

*Maxillae*.—Similar to those figured for *J. rajata* (see figs. 21, *c*, and 22, *e*).

*Mandible*.—In general as that figured for genotype. Right mandible with incisor process having five teeth, setal row with ten setae, molar process with numerous setae along denticulate inferior margin and a large tooth; palp 3-jointed, second joint as shown in figure 24, *c*. Left mandible differs from right in having seven setae in setal row and a 4-toothed lacina.

*Pleopods*.—The male first pleopods have not as yet been described or figured. The specimens I have seen were all females.

*Measurements*.—Figured female paratype, length 4.9 mm., width at widest part of second peraeon somite 2.0 mm.

*Type locality*.—Hood Canal, Wash.

*Geographical distribution*.—Pacific coast of North America from Alaska to Washington.

*Material examined*.<sup>4</sup>—ALASKA: *Dall Island*, Cape Mazon, September 4, 1934, 70 meters, 1 female. BRITISH COLUMBIA: *Langara Island*, Egeria Bay, September 3, 1934, 50–90 meters, 1 female. WASHINGTON: *Cypress Island*, August 7, 1940, 30 fathoms, 1 female; *Hood Canal*, July 26, 1940 (T. Kincaid), 10 females; *Waldron Island*, August 6, 1940, 40 fathoms (M. H. Hatch), 1 female.

*Remarks*.—The original figure of the cephalon of *J. solasteri* (Hatch, 1947, fig. 160) is, I believe, misleading in that the anterolateral lappets of the cephalon, a conspicuous feature of this species, appear to be bent downward and inward to give a most unusual appearance to the cephalon. All the paratypes of this species that I examined had cephalons similar to that shown in figure 24, *a*. In one specimen the rostral process was bent considerably downward; however, it was apparent that this was accomplished by some external force and was not a natural condition.

#### JANIRALATA OCCIDENTALIS (Walker)

##### FIGURES 23, *a–d*

*Janira occidentalis* WALKER, 1898, pp. 280–281, pl. 15, figs. 7–10.—RICHARDSON, 1899a, p. 859; 1899b, p. 326; 1900, p. 300; 1904a, p. 224; 1904b, p. 667; 1905, pp. 472–473, figs. 526–528.—STAFFORD, 1913, pp. 183–185, fig. 7.—HATCH, 1947, p. 172, pl. 111, figs. 35–36.

<sup>4</sup>Paratype females kindly lent to the writer by Dr. Melville H. Hatch, Zoology Department, University of Washington, Seattle, Wash.

*Diagnosis*.—Cephalon anteriorly with a very short triangulate median projection and an angulate expansion at each anterolateral angle. Eyes dorsal, separated from lateral border by a distance equal to the width of one eye. Lobate lateral expansions of second and third peraeon somites separated from one another by a distance exceeding two times the length of anterior lobe. Pleotelson with spinelike, medially recurved, posterolateral projections and a slightly trilobate posterior margin whose medial lobe extends posteriorly beyond the posterior extent of the posterolateral angles. Body and pleotelson lateral areas setiferous. Male first pleopod structure not known.

#### SUPPLEMENTARY DESCRIPTIVE NOTES

*Cephalon*.—Wider than long, anteriorly with a small triangulate median lobe, two wide mediolateral lobes and an angulate setiferous projection at each anterolateral border. Eyes dorsal, bulging, located a distance equal to the width of an eye from lateral border.

*Peraeon*.—First somite with a trilobate lateral border, the medial and perhaps the anterior lobes representing epimeral lobes. Lateral borders of sixth and seventh somites with a small posteromedial lobe. Epimera bilobed, anterior lobe the larger.

*Pleotelson*.—Pleotelson with a medially recurved spinelike projection at each posterolateral angle; posterior margin trilobate, median lobe exceeding the posterior extent of posterolateral angles. Lateral borders setiferous.

*Maxilliped*.—With three coupling hooks.

*Mandible*.—Right mandible with incisor process having 5 teeth, setal row with 15 setae, molar process with 10 setae along denticulate inferior margin and a large tooth; palp 3-jointed, second joint as shown in figure 23, *d*. Left mandible differing from right in having a 4-toothed lacinia and nine setae in setal row.

*Peraeopods*.—First peraeopod propodus with a row of 15 serrations on inferior proximal margin; carpus expanded, with eighteen 2-pointed setae along inferior margin.

*Uropods*.—As long as pleotelson, inner branch slightly longer than outer branch.

*Pleopods*.—The male first pleopods have not as yet been described or figured. The specimens I have seen were females.

*Measurements*.—Figured ovigerous female hypotype, length 5.4 mm., width at widest part of second peraeon somite 2.1 mm.

*Type locality*.—Puget Sound, Wash.

*Geographical distribution*.—Pacific coast of North America, from Turn Rock, Turn Island, San Juan County, Wash., to Laguna Beach, Orange County, Calif.

*Material examined*.—WASHINGTON<sup>5</sup>: *San Juan County*, Turn Rock, Turn Island, July 4 and 7, 1940, under rock at low tide (F. A. Pitelka), 2 females, one ovigerous. CALIFORNIA<sup>6</sup>: *Monterey County*, Point Pinos, July 4, 1947, under submerged rock (John Davis), 1 ovigerous female.

#### OTHER SPECIES ASSIGNED TO JANIRALATA

In addition to the species already discussed, several others appear from their descriptions also to belong in the genus *Janiralata*. The species for which the generic assignments are fairly certain are *Iolella alascensis* Benedict, 1905 (Richardson, 1905b, p. 464), *Tole holmesi* Richardson, 1905 (as *Iolella* in Richardson, 1905b, p. 465) and *Iolella sarsi* Richardson, 1905b, p. 467. The following species I doubtfully refer to *Janiralata*: *Ianthe erostrata* Richardson, 1899 (as *Iolella erostrata* in Richardson, 1905b, p. 465), *Ianthe triangulata* Richardson, 1899 (as *Iolella* in Richardson 1905b, p. 462), and *Janira soldatovi* Gurjanova, 1933, pp. 81–82, 90.

In my opinion, Vanhöffen's placement of the species *alascensis*, *triangulata*, *erostrata*, *holmesi*, and *sarsi* in Beddard's genus *Janthopsis* is less warranted than the placement, by other authors, of those species in *Janira* or even in *Iolella*. *Iolella* (= *Ianthe*) and *Janira* both differ from *Janthopsis*, as Beddard points out (Beddard, 1886, pp. 14–15), in having uropodal branches subequal in length to each other and to the basal or peduncular joint. In *Janthopsis* the basal joint exceeds twice the length of the longest uropodal branch. The male first pleopods appear, from the figures I have seen, to differ considerably from those figured for *Janthopsis* (Beddard, 1886, pl. 5, figs. 6, 7). Further differences do exist (see Nordenstam, 1933, pp. 180–183); however, it seems unnecessary to enumerate them here.

#### A KEY TO THE SPECIES OF JANIRALATA

- a<sup>1</sup>. Pleotelson with distinct medially recurved, spinelike posterolateral angles.
- b<sup>1</sup>. Cephalon lateral margin with a deep incision---- *triangulata* (Richardson)
- b<sup>2</sup>. Cephalon lateral margin entire.
- c<sup>1</sup>. Cephalon anterolateral angles bifurcating----- *holmesi* (Richardson)
- c<sup>2</sup>. Cephalon anterolateral areas blunt or angulate, not bifurcating.
- d<sup>1</sup>. Cephalon anterolateral areas blunt----- *sarsi* (Richardson)
- d<sup>2</sup>. Cephalon anterolateral areas angulate.
- e<sup>1</sup>. Cephalon with an elongate pointed rostral projection; spinelike posterolateral angles of pleotelson slightly exceeding the posterior extent of medial posterior pleotelson lobe----- *solasteri* (Hatch)

<sup>5</sup> Specimens lent to writer by Dr. Melville H. Hatch, Zoology Department, University of Washington, Seattle, Wash.

<sup>6</sup> Specimen lent to writer by Dr. Frank A. Pitelka, Zoology Department, University of California.

- c*<sup>2</sup>. Cephalon with a short triangulate rostrum; spinelike posterolateral angles of pleotelson not exceeding the posterior extent of medial posterior pleotelson lobe----- *occidentalis* (Walker)
- a*<sup>2</sup>. Pleotelson posterolateral areas evenly curved, lacking distinct angles or spinelike processes.
- b*<sup>1</sup>. Cephalon lacking expanded anterolateral angles----- *rajata*, new species
- b*<sup>2</sup>. Cephalon with expanded anterolateral angles.
- e*<sup>1</sup>. Cephalon rostral projection exceeding the anterior extent of anterolateral angles----- *alascensis* (Benedict)
- e*<sup>1</sup>. Cephalon with or without a small rostral projection which, if present, does not exceed the anterior extent of anterolateral angles.
- d*<sup>1</sup>. Posterior pleotelson border consisting of three equally produced prominent lobes.
- e*<sup>1</sup>. Dorsal surface of pleotelson with a row of setae above insertion of each uropod<sup>7</sup>----- *soldatovi* (Gurjanova)
- e*<sup>2</sup>. Dorsal surface of pleotelson lacking a row of setae above insertion of each uropod----- *erostrata* (Richardson)
- d*<sup>2</sup>. Posterior pleotelson border with a single median lobe.
- davisi*, new species

#### REMARKS CONCERNING HANSEN'S CONCEPT OF JANIRA LEACH

Hansen (1916, p. 21) canceled *Iolella* Richardson, 1905 (also known as *Ianthe*, *Tole*, and *Iole*) simply by considering the genotype of *Iolella*, *Ianthe speciosa* Bovallius, a synonym of *Ianira spinosa* Harger. Whether he was justified in this decision remains problematical. Richardson (1905b, p. 460) did not agree with Hansen in this respect and was severely criticized by Hansen (1916, p. 22) for this view. Hansen wrote, "But as she [Richardson] had not seen any specimen referred to *I. speciosa* and not any further material, the statement, 'I find it [*I. speciosa*] distinct from *I. spinosa*', is of no value."

Since specimens, in particular the types, of neither species are available to me, I am unable to resolve this dispute. Assuming for the present that Richardson was correct and Hansen incorrect, then one must determine whether *Iolella* has any morphological characteristics that separate it from *Ianira* (auct. *Janira*). Hansen did not believe so and writes, "*Iolella* Richardson with its synonyms . . . can not be separated from *Ianira* in any natural way." In that respect I cannot agree with Hansen, and I feel that I can substantiate my belief, in part at least, with Hansen's own statements. Since Hansen considered *Ianthe speciosa* Bovallius (the genotype of *Iolella*) a synonym of *Ianira spinosa* Harger any generic remarks he would have concerning *I. spinosa* probably also apply to *I. speciosa*. He writes of *I. spinosa* Harger, "Epimeral processes are completely

<sup>7</sup> If this is an error (Gurjanova, 1933, p. 90, English translation), as it might possibly be, then I should, with little hesitation, consider *J. soldatovi* a synonym of *J. erostrata*. In *J. erostrata* and the other species of this genus the ventral surface of the pleotelson does have a row of setae anterior to the insertion of each uropod; however, Gurjanova definitely states that two rows of setae (=spines) are present on the dorsal pleotelson surface in *J. soldatovi*.



wanting at the lateral lappets of the three anterior thoracic segments . . . ,” and of *Ianira maculosa* Leach, the genotype of *Ianira*, he writes, “Epimeral plates developed at all thoracic segments.” Such differences, in my opinion, certainly separate the two genera and in a very natural way, especially when they are reinforced by other morphological evidence. The male first pleopods of *Iolella lacinata* (G. O. Sars) differ considerably from those of *Ianira maculosa* Leach. Since the structure of the male first pleopods of *Iolella spinosa* (Harger) and *I. speciosa* Bovallius is not known, I cannot be certain that they are structurally similar to those of *Iolella lacinata*; however, the probability is good that they are similar. *I. maculosa* and its related species *I. alta* and *I. tricornis* lack elongate, pointed, posterolateral telsonic lappets, with structures as well developed on *Iolella speciosa*, *I. spinosa*, and *I. lacinata*. I believe that here, then, are other structural features separating the two groups of species. The total of the differences, in my opinion, makes it necessary that the groups of species as typified by *Ianira maculosa*, on the one hand, and *Iolella speciosa*, on the other hand, be generically separated from one another. The other problem exists, however; if *Iolella speciosa* is a synonym of *Iolella spinosa*, as Hansen asserts, then a genotype should be selected for the species resembling *I. speciosa*. Since I cannot at present settle the question with certainty, I arbitrarily accept Richardson’s statement that the species in question are distinct from one another. Such an acceptance, with due regard to Dr. Hansen, does, of course, permit less change in the existing nomenclature and for that reason appears to be the more desirable alternative.

Group MUNNINI Hansen, 1916

Subgroup PLEUROGONIINI \* Nordenstam, 1933

Genus PLEUROGONIUM G. O. Sars

PLEUROGONIUM CALIFORNIENSE, new species

FIGURES 25, 26

*Holotype*.—Male, length 1.25 mm., width at widest part of second pereaeon somite 0.8 mm.

*Allotype*.—Length 1.1 mm., width 0.6 mm.

*Diagnosis*.—First pereaeon somite exceeding twice the length of second, posterolateral edges evenly curved, lacking spines; anterolateral angles each with a large anterolaterally directed spine. Epimeral spines of second to sixth somites located at posterior angle of the epimeral plates. Pleotelson with a distinct constriction at anterior end and with smooth lateral borders beset with a few small setae.

\* Considered by Nordenstam, p. 199, to be a subgroup of Hansen’s Munnini.

Maxilliped with two coupling hooks. Apex of male first pleopods shorter than is usual for members of this genus.

*Character of body.*—Flattened with ovoid lateral outline. The most conspicuous features are the absence of chromatophores and eyes and the presence of very large epimeral spines. Body smooth on dorsal surface, lacking any conspicuous setae. Some microscopic setae are present especially at the borders of each somite.

*Cephalon.*—Wider than long. Anterior border triangulate with convex anterior portion of upper lip visible in dorsal view. Lateral borders occupied by the insertion of the first antennae. Eyes lacking, dorsolateral ovoid muscle insertions are evident in a position where they might be mistaken for eyes.

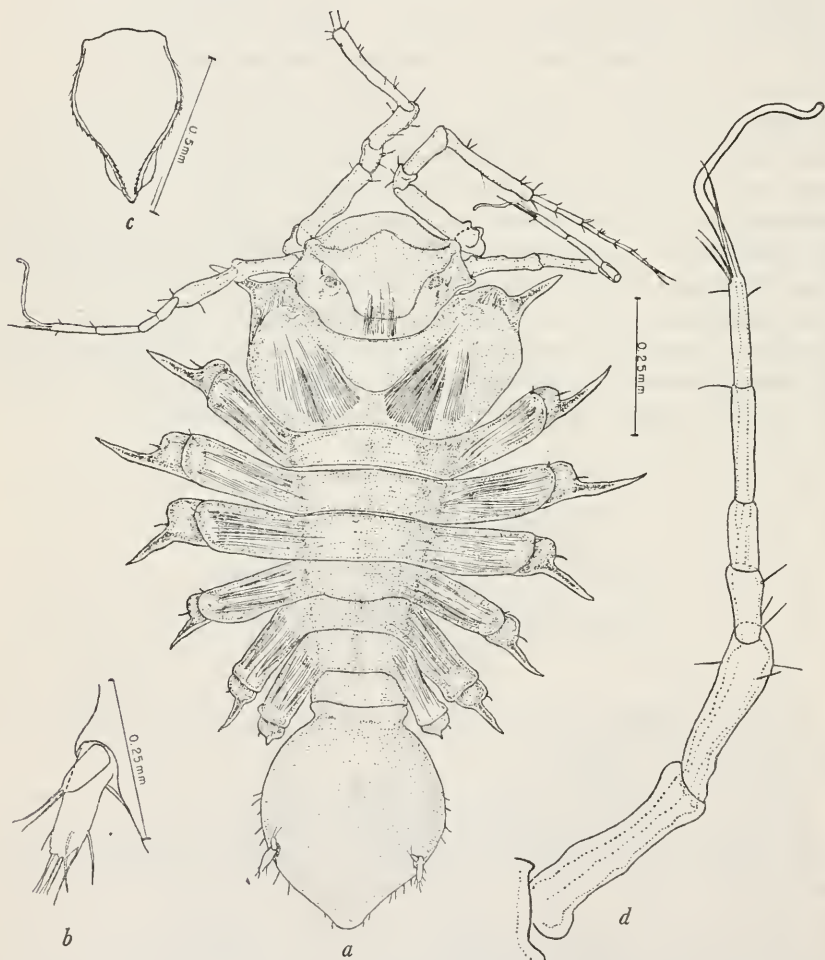


FIGURE 25.—*Pleurogonium californiense*, new species: *a*, Holotype male; *b*, left uropod, holotype; *c*, operculum, allotype; *d*, left first antenna, holotype. (Magnification as indicated by scales: *d* same as *b*.)

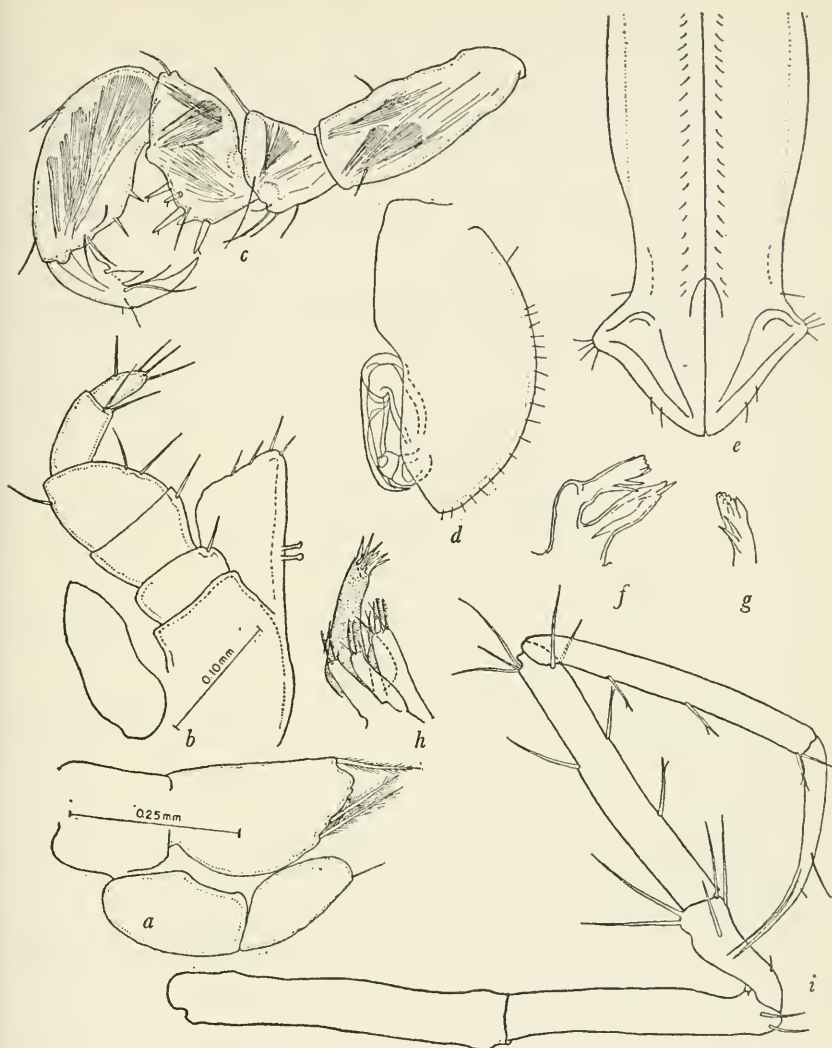


FIGURE 26.—*Pleurogonium californiense*, new species: *a*, Left third pleopod, male paratype; *b*, maxilliped, male paratype; *c*, right gnathopod, holotype; *d*, left second pleopod, male paratype; *e*, male first pleopod, paratype; *f*, right mandible, male paratype; *g*, incisor process of left mandible, male paratype; *h*, right first and second maxillae, male paratype; *i*, right seventh pereopod. (Magnification as indicated by scales: *c-e* and *i* same as *a*; *f-h* same as *b*.)

*Peraeon*.—Lateral borders of first somite markedly anteriorly produced, those of somites 2 and 3 less so, that of somite 4 laterally directed, those of somites 5 to 7 posterolaterally directed. First somite exceeding twice the length of second somite, somites 2 to 7 short and subequal in length. Epimeral plate of first somite not separated from somite and bearing a long, narrow, anterolaterally directed epimeral

spine. Epimeral plates of somites 2 to 7 distinctly separated from somites and visible in dorsal view. Second to sixth epimeral plates with an epimeral spine at posterior angle; spine of seventh located anterior to posterolateral angle of the epimeron and smaller than those on the other somites. Epimeral spines largest and longest on the third somite. Epimeral plates each with a large seta anterior to epimeral spine. First peraeon somite with posterolateral edges broadly curved.

*Pleon*.—Composed of a short anterior somite and a bulbous pleotelson which bears a distinct constriction slightly posterior to first pleon somite. Lateral margins of pleotelson with a few setae.

*First antenna*.—Located on lateral margin of cephalon and very slightly posterodorsal to second antenna insertion. Peduncle composed of two long subequal segments. Flagellum composed of four segments, first two subequal in length and together equal the length of fourth. Fourth flagellar segment with a single long sensory filament and a few smaller setae at apex. It is difficult to tell where the peduncular segments stop and the flagellar segments commence. I have considered the last four segments as flagellar segments primarily because they differ from one another very slightly and are conspicuously narrower than the other segments.

*Maxilliped*.—With two coupling hooks. Palp with five segments, first three as wide as endite, last two one-half the width of third segment.

*First maxilla*.—Outer lobe with seven stout setae, inner lobe with three setae.

*Second maxilla*.—Each of the two outer lobe lappets with three or four denticulate setae at apex. Inner lobe with five setae.

*Mandible*.—Incisive process consisting of a double row of five small teeth; setal row with two spinelike setae. Molar process sword-shaped, having a single apical seta. Palp and lacina lacking. Left and right mandibles similar.

*Gnathopod*.—Those of male and female similar. Dactylus with two claws, propodus with two large setae on inferior margin, carpus with four 2-pointed setae on ventral margin and a spinelike process at the triangulate apex of inferior margin.

*Other peraeopods*.—All similar and spindly. Seventh peraeopod dactylus with two long narrow claws; dactylus exceeds one-half the length of propodus; prodopod with three 2-pointed setae on inferior border, carpus with two 2-pointed setae on inferior border.

*Uropods*.—Two-branched, similar to those of the other species in the genus.

*Pleopods*.—Male first pleopods medially fused, posterior margin less pointed than is usual in the genus. Operculum of female pyriform, apex pointed, lateral borders setiferous.



*Types*.—Holotype (U.S.N.M. No. 87412), allotype (U.S.N.M. No. 87413), and 1 male paratype (U.S.N.M. No. 87414) collected at type locality, 3 miles west of mouth of Russian River, Sonoma County, Calif., July 13, 1947, by R. J. Waidzunas and Paul B. Quyle; found in fine mud with the sea-star *Luidia foliolata* Grube and an apparently new species of marine isopod belonging to the genus *Ianiropsis*.

*Geographical distribution*.—Known only from the type locality.

*Remarks*.—This species appears to be most closely related to *Pleurogonium albidum* Beddard. It differs from that species in having its pleotelson widely ovate and the length of the first peraeon somite more than twice the length of the second peraeon somite. In *P. albidum* the pleotelson is narrow and the first peraeon somite is considerably shorter than the second peraeon somite.

Subgroup ANTIASINI<sup>9</sup> Nordenstam, 1933

Genus ANTIAS Richardson

ANTIAS HIRSUTUS, new species

FIGURES 27, 28

*Holotype*.—Male, length 1.2 mm, width at widest part of second peraeon somite 0.6 mm.

*Allotype*.—Length 1.5 mm., width 0.7 mm.

*Diagnosis*.—Eyes on short stalks. Frontal margin bifurcating. Preocular lobes large but not curved outward. First antenna flagellum with three segments, last segment with a single sensory filament and a few setae at apex. Peraeon somites 1 to 4 with lateral borders straight or very slightly convex. Epimeral plates visible in dorsal view on somites 5 to 7 only. Mandibular palp not observed, apparently lacking. Body covered with many large setae. Uropods with short straight branches, peduncle slightly longer than branches and is widest at distal end.

*Character of body*.—Dorsal and lateral surfaces of body covered with many large setae. Cephalon and fourth peraeon somite with numerous black chromatophores; mediolateral areas of first to third peraeon somites with a longitudinal line of black chromatophores; remainder of animal cream colored.

*Cephalon*.—Wider than long, eyes small and on short stalks at posterolateral angles of cephalon. Preorbital lobe distinct, separated from eye by a deep lateral depression. Frontal margin emarginate, lateral lobes fringed with setae.

*Peraeon*.—Anterior border of first somite slightly concave. Somites one to four with lateral borders straight or slightly convex, all borders fringed with long setae. Lateral borders of somites 6 and 7

<sup>9</sup> Considered by Nordenstam, p. 200, to be a subgroup of Hansen's Munnini.

markedly convex, fringed with setae. Epimeral plates visible in dorsal view at posterolateral areas of somites 5 to 7 only.

*Pleon.*—Composed of a narrow, short anterior segment whose posterior border is convex and fringed with a few setae and a shieldlike

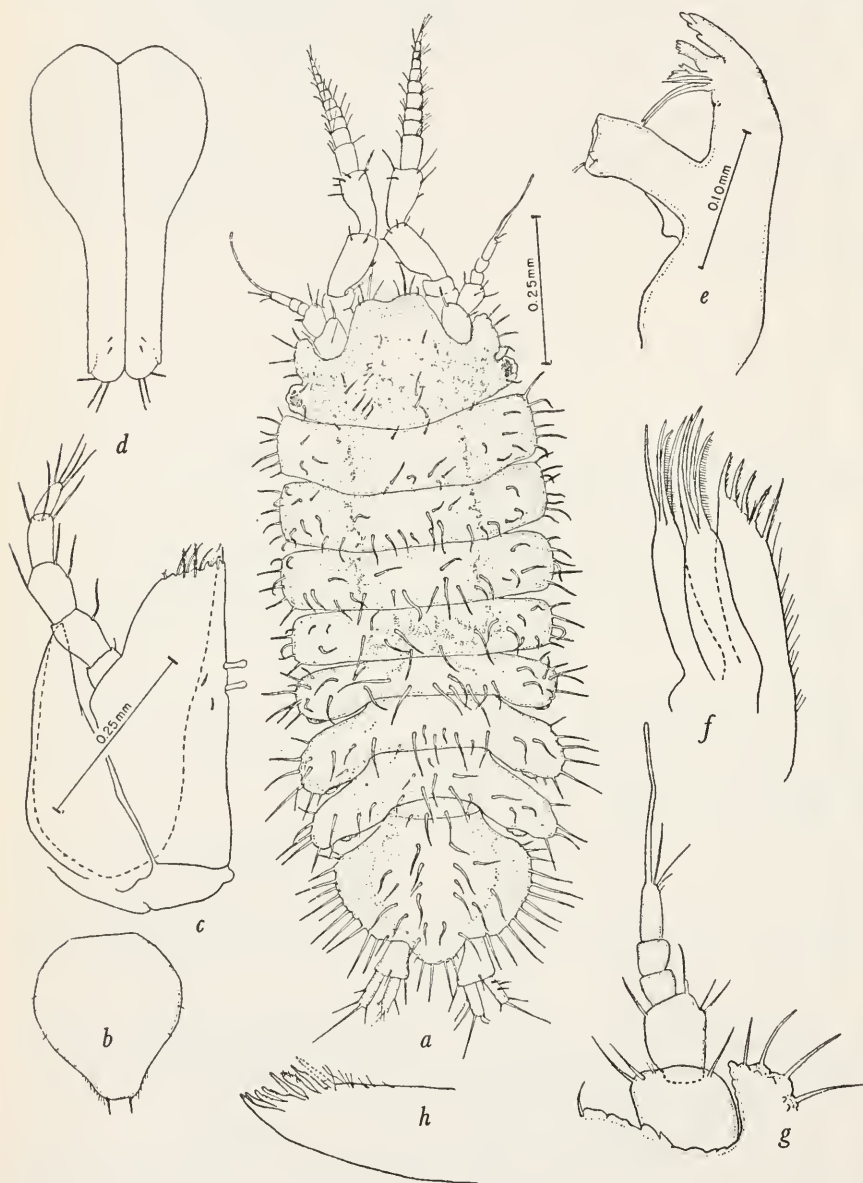


FIGURE 27.—*Antias hirsutus*, new species: a, Holotype male; b, female operculum, paratype; c, maxilliped, ovigerous female paratype; d, first pleopods, holotype; e, left mandible, male paratype; f, right second maxilla, ovigerous female paratype; g, first antenna, holotype; h, outer lobe of first maxilla, ovigerous female paratype. (Magnification as indicated by scales: b same as a; d and g same as c; f and h same as e.)

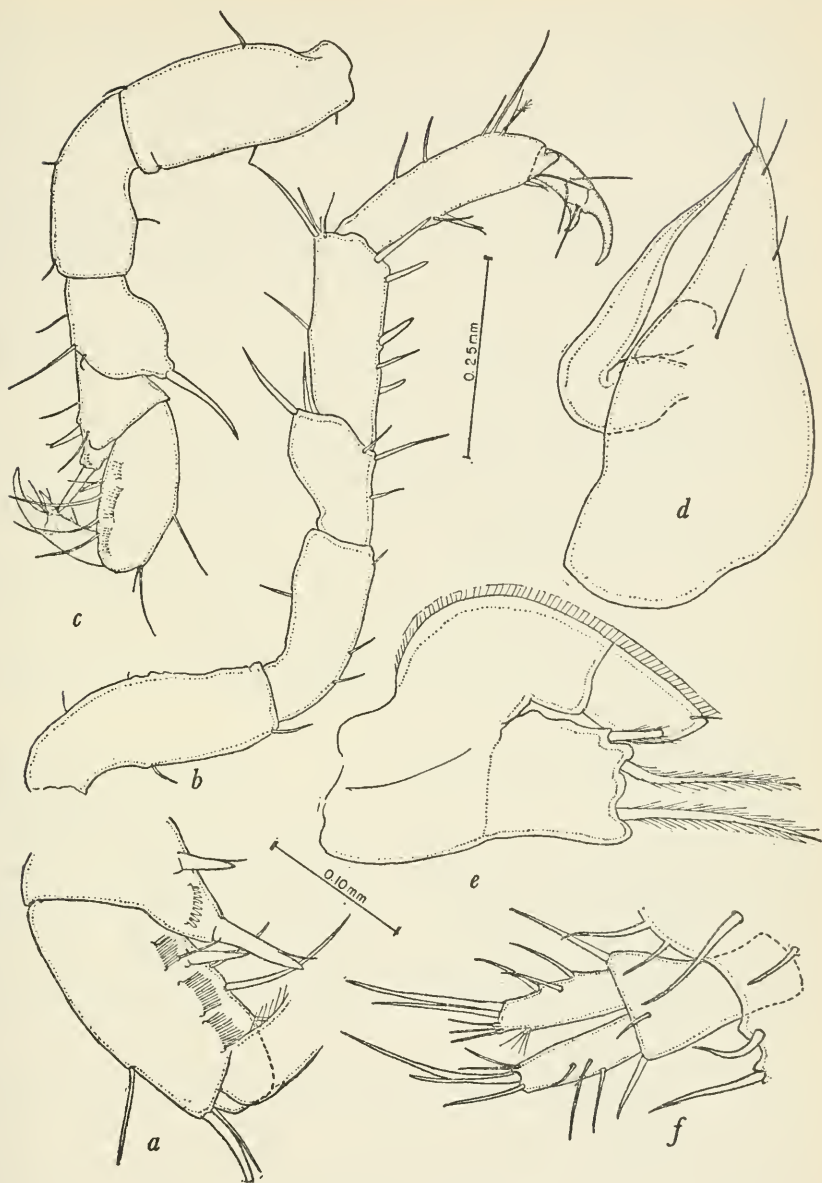


FIGURE 28.—*Antias hirsutus*, new species: *a*, Right first peraeopod, holotype; *b*, right seventh peraeopod, holotype; *c*, right first peraeopod, holotype; *d*, right second male pleopod, paratype; *e*, third male pleopod, paratype; *f*, right uropod, allotype. (Magnification as indicated by scales: *d* and *e* same as *a*; *c* and *f* same as *b*.)

pleotelson, also fringed with setae and having a very distinct median lobe on posterior margin. Pleotelson posterolateral areas not projecting.

*First antenna.*—Peduncle composed of two wide joints, the first being two times the width of second. Flagellum composed of three joints, first two joints subequal in length and together about equal the length of last joint. Last joint with a single long sensory filament and a few setae at tip.

*Second antenna.*—Peduncle composed of six segments. First four segments subequal in length, fifth about two times the length of prior four and slightly longer than sixth segment. Flagellum as long as peduncle and composed of 10 segments. Antennal scale not observed.

*Maxilliped.*—With two coupling hooks. All five joints of palp of similar width, last two being slightly narrower than the first three; third joint about one-fourth the width of endite.

*First maxilla.*—Outer lobe with eight denticulate setae at apex and a few marginal setae. Endite with four apical setae.

*Second maxilla.*—Each of the two outer lobe lappets with four denticulate apical setae. Inner lobe with five ciliate setae at apex and numerous fine marginal setae.

*Mandible.*—Palp not observed. Left mandible molar process cylindrical, with truncate, unidentate, setiferous apex; incisor process and lacina with four teeth; setae row with two wide dentate setae followed by three narrow setae. Right mandible similar to left but lacking a lacina and having a large lacinoid seta followed by four smaller setae in setal row.

*First peraeopod.*—Dactyl with two claws. Propodus with a single 2-pointed seta and four narrow setae on inferior margin behind which are three pectinate scales. Carpus with a large 2-pointed seta at inferodistal angle behind which is a thick-toothed pectinate scale; a smaller 2-pointed seta present on inferior margin proximal to the large one. Merus with a large seta at superodistal angle.

*Other peraeopods.*—Dactyls with two claws. Seventh peraeopod with two 2-pointed setae on inferior propodal margin and five setae on carpal inferior margin.

*Uropod.*—Peduncle joint widest at distal end. Inner and outer branches about equal in length being slightly shorter than peduncle and possessing blunt ends.

*Pleopods.*—First male pleopods not widened distally, with blunt, paucisetiferous tips. Second male pleopod outer lamellar plate with an acute apex; inner styliiform proximal branch originating at middle of medial margin of outer branch slightly curved and extending to tip of outer branch; inner distal branch short, with blunt tip and in contact with proximal branch near its origin. Third male pleopod inner branch with three plumose setae on distal margin. Female operculum with truncate apex on either side of which is a fairly large seta.



*Types*.—Holotype male, allotype, and 5 male and 2 female paratypes collected at type locality, Tomales Bluff, Tomales Point, Marin County, Calif., June 9, 1948, by R. J. Menzies; in rock and sand between coralline and laminarian algal zones; intertidal. Type material has been deposited as follows:

United States National Museum, holotype male, No. 87411; allotype, No. 87409; 1 male and 1 ovigerous female paratype, No. 87410. Allan Hancock Foundation, 2 male paratypes. Pacific Marine Station, 2 male and 1 fragmentary female paratypes, accession No. 1219 Arth.

*Geographical distribution*.—Known only from the type locality.

*Remarks*.—This species appears to be intermediate between *A. hispidus* Vanhöffen and *A. charcoti* Richardson (as figured by Hodgson 1910, pl. 9, figs. 1). It differs from *A. hispidus* in having a bifurcating rostrum and pronounced preocular lobes. It differs from *A. charcoti* in lacking a mandibular palp, in having an antennular flagellum composed of three joints, preocular lobes that are not curved outward, and a different-shaped pleotelson and uropods.

Group JAEROPSINI<sup>10</sup> Nordenstam, 1933

Genus JAEROPSIS Koehler

JAEROPSIS DUBIA, new species

FIGURES 29–33

*Holotype*.—Length 2.8 mm., width at widest part of second peraeon somite 0.7 mm.

*Allotype*.—Length 2.3 mm., width 0.6 mm.

*Diagnosis*.—Eyes located close to lateral margin. Anterolateral angles of cephalon pointed, lacking deep anteriorly directed serrations. Rostral process evenly curved and fringed with a delicate margin of wide scales. Maxilliped endite with three coupling hooks. Both inner and outer distal angles of second joint of maxilliped palp produced distally, inner angle bidentate. Pleotelson with a row of five to seven spines on each lateral border. Between each pleotelson spine is a row of three or four setae. Head generally heavily pigmented, body and abdominal segments very lightly pigmented or without pigments. Penultimate joint of second antenna peduncle with fringe of conspicuous scales on lateral margin. Exopodite of uropods with two joints.

*Character of body*.—Animal appears elongate and flattened. Many specimens have a wide median longitudinal thickening running the length of the peraeon. In a few specimens the thickening is not pronounced. Body smooth on dorsal surface, lacking any conspicuous setae. Color variable with the following variations observed: (1) Head black or brown, remainder of body brownish white; (2)

<sup>10</sup> Considered by Nordenstam, p. 190, to be a new group of the family Parascyllidae.

head white, body white, eyes red (albino?); (3) head black, a black line along midline of body from head to pleotelson (var. *paucispinis*, see p. 155); (4) head and fourth peraeon somite black, remainder of body white (var. *paucispinis*, see p. 155).

*Cephalon*.—Wider than long. Anterolateral angles acute, projecting frontally. Frontal margin with two deep lateral concavities

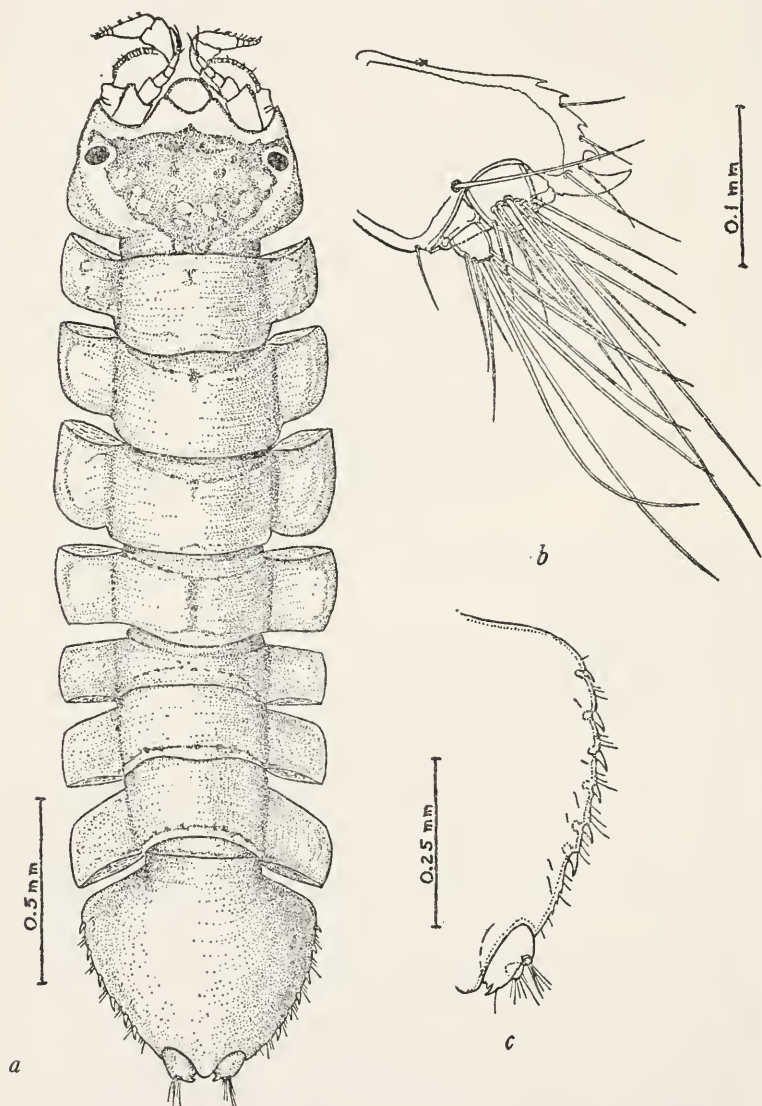


FIGURE 29.—*Jaeropsis dubia*, new species: *a*, Female paratype; *b*, inner view of uropod, paratype; *c*, pleotelson lateral border, paratype female. (Magnification as indicated by scales.)

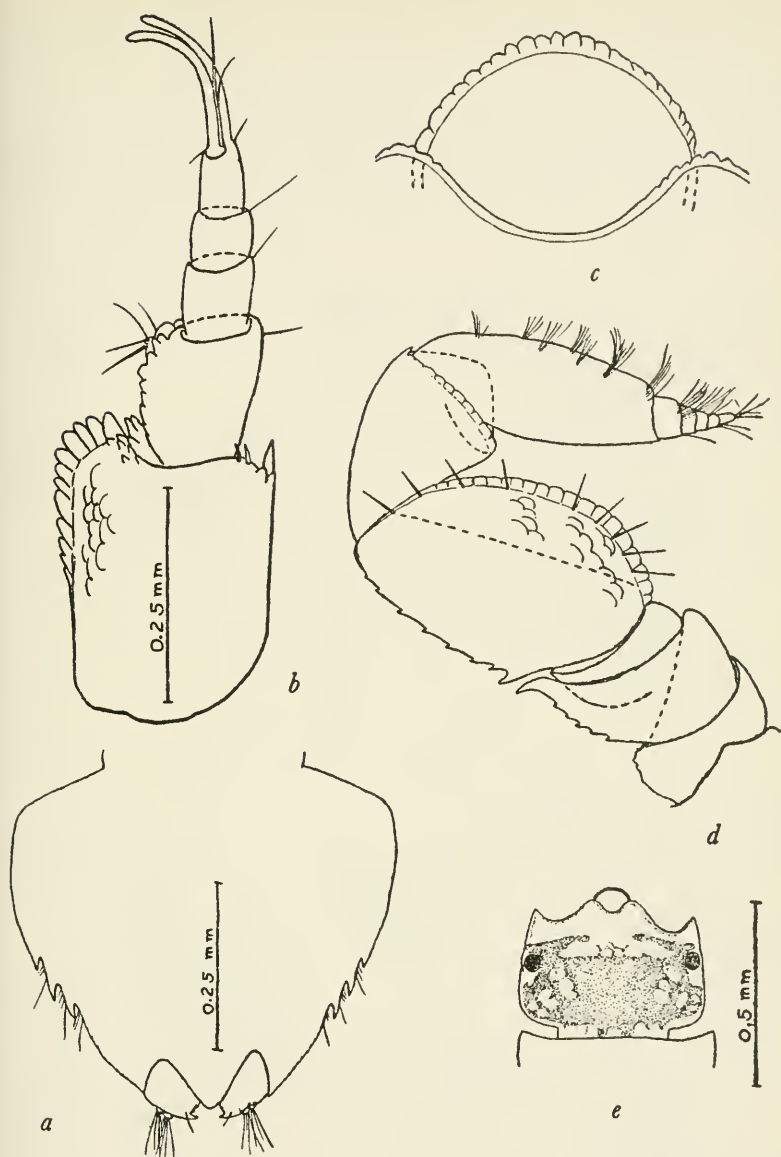


FIGURE 30.—*Jaeropsis dubia*, new species: *a*, pleotelson of *J. d. paucispinis*, new variety; *b*, first antenna, female paratype; *c*, rostral process, female paratype; *d*, second antenna, female paratype; *e*, cephalon, var. *paucispinis*. (Magnification as indicated by scales: *c* same as *b*; *d* unknown.)

separated medially by a deep but more anteriorly produced concavity into which fits the rostral projection. Rostral projection semicircular in outline, bearing a conspicuous fringe of scales. Eyes dorsal, near lateral margin in upper third of cephalon. Color pattern frequently of the type shown in figure 29, *a*.

*Peraeon*.—No epimeral plates visible in dorsal view. Lateral borders of peraeon somites slightly convex. Second somite longest; fifth shortest.

*Pleon*.—Composed of two somites, a short anterior somite and a wide shieldlike pleotelson. Pleotelson with five to seven large spines on each lateral border. Three or four setae between each spine. Pos-

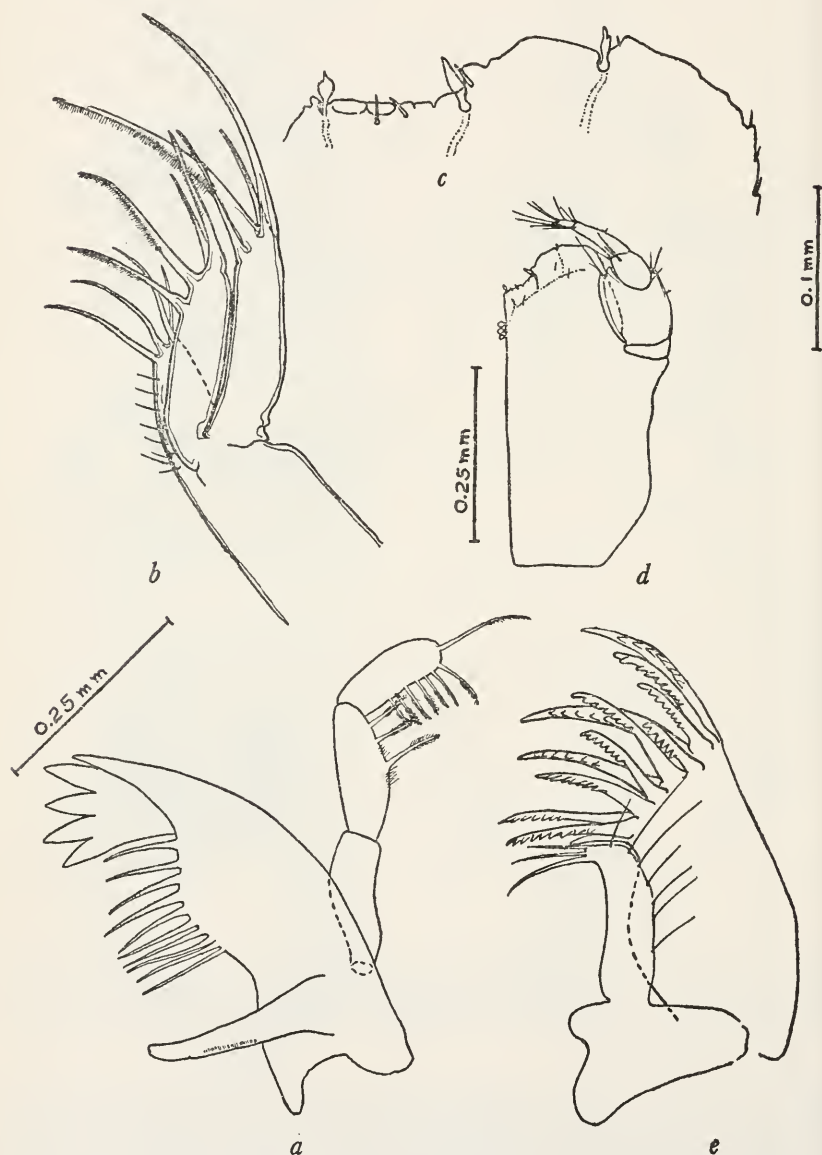


FIGURE 31.—*Jaeropsis dubia*, new species, female paratype: *a*, Left mandible; *b*, left second maxilla; *c*, distal border of maxilliped endognath; *d*, maxilliped; *e*, left first maxilla. (Magnification as indicated by scales: *b* and *e* same as *a*.)



terior margin with a semiacute median projection, which does not extend distally beyond the uropods.

*First antenna*.—Peduncle composed of two joints, first joint about twice the length and width of second and beset with a fringe of scales on lateral margin and a stout spine at anteromedial edge; second joint with scales on lateral margin, medial margin smooth. Flagellum with three subequal joints, last joint with two elongate sensory filaments and a few setae at tip.

*Second antenna*.—About as long as cephalon. Peduncle composed of six joints; first three joints partially fused, fourth joint deeply immersed in third joint, fifth joint about two times the length of third and beset with a fringe of flat scales on the lateral and spinelike scales on the medial margins, sixth joint as long as third. Flagellum about one-half the length of peduncle, composed of six joints; first joint about twice the combined lengths of following five joints, inner margins of all joints setiferous.

*Maxilliped*.—With three coupling hooks. Palp composed of five segments; second joint expanded, being about one-half the width of endite and possessing a produced bidentate inner distal angle; last three joints considerably narrower than second joint.

*First maxilla*.—Outer lobe with 11 denticulate setae at apex, inner lobe with three apical setae.

*Second maxilla*.—Each of the two outer lobe lappets with four apical setae, inner lobe with four apical setae.

*Mandible*.—Left and right mandibles similar, lack lacina. Incisive part with five teeth, setal row with 10 setae, molar process fingerlike. Palp composed of three subequal joints, second joint with three spinulate setae on distal half, third joint with eight spinulate setae.

*First peraeopod*.—Dactylus with two claws, propodus with three 2-pointed setae on inferior margin, merus and ishium with projecting scales on superior border.

*Seventh peraeopod*.—Dactylus with three claws, propodus inferior border with four 2-pointed setae. Projecting marginal scales on dorsal border of ishium and distal border of basis.

*Other peraeopods*.—Similar to seventh in having three claws on dactyls.

*Uropod*.—Peduncle composed of a thick joint having a large medially curved spine at distal end on medial margin; medial margin of peduncle spinulate. Endopodite cylindrical, composed of a single thick joint beset with a circle of long setae at tip. Exopodite consisting of two short joints, a minute, scarcely discernible basal joint, and a nodiform distal joint whose tip bears a number of long setae.

*Pleopods*.—First male pleopods with produced, truncate posterolateral angles and a medially produced setiferous distal border. Female operculum pyriform, apex setiferous.

*Types*.—Holotype and allotype collected at First Sled Road, north of Pacific Marine Station, Dillon Beach, Marin County, Calif., December 10, 1947, by R. J. Menzies; under stones at low-tide line (−0.7 foot). Type material has been deposited as follows:

United States National Museum, holotype male, No. 87697; allotype, No. 87698; 8 male and 10 female paratypes, Nos. 87699–87700. Allan Hancock Foundation, 4 male and 14 female paratypes. Pacific Marine Station, 10 male and 14 female paratypes, accession Nos. 1229–1239 Arth.

*Geographical distribution*.—California, from Dillon Beach, Marin County, to Newport Bay, Orange County.

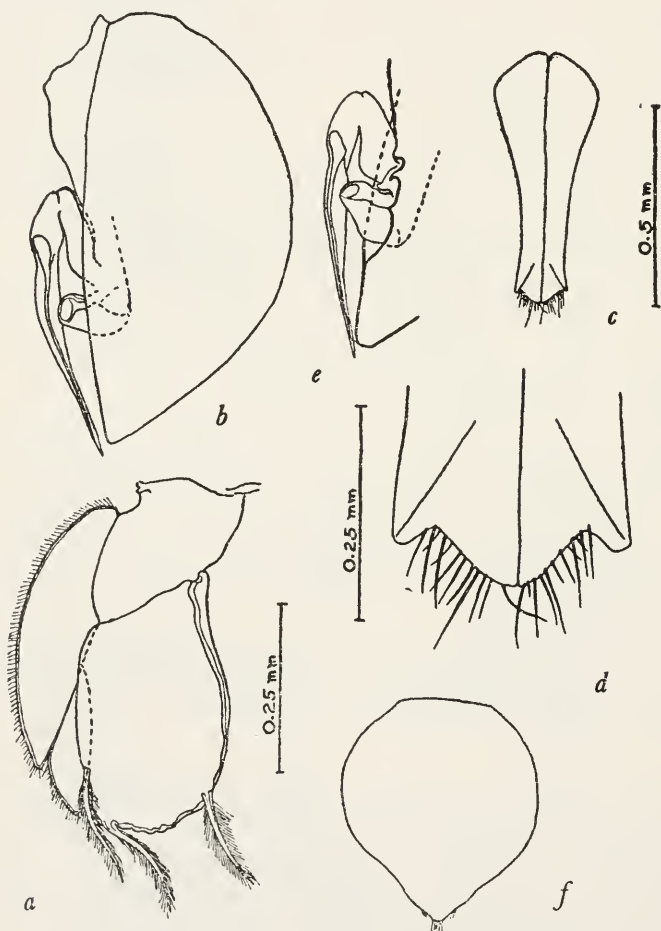


FIGURE 32.—*Jaeropsis dubia*, new species: *a*, Third male pleopod; *b*, second male pleopod; *c*, first male pleopods; *d*, distal margin of first male pleopods; *e*, inner view of medial margin of second male pleopod; *f*, female operculum. (Magnification as indicated by scales: *b* and *e* same as *a*; *f* same as *c*.)

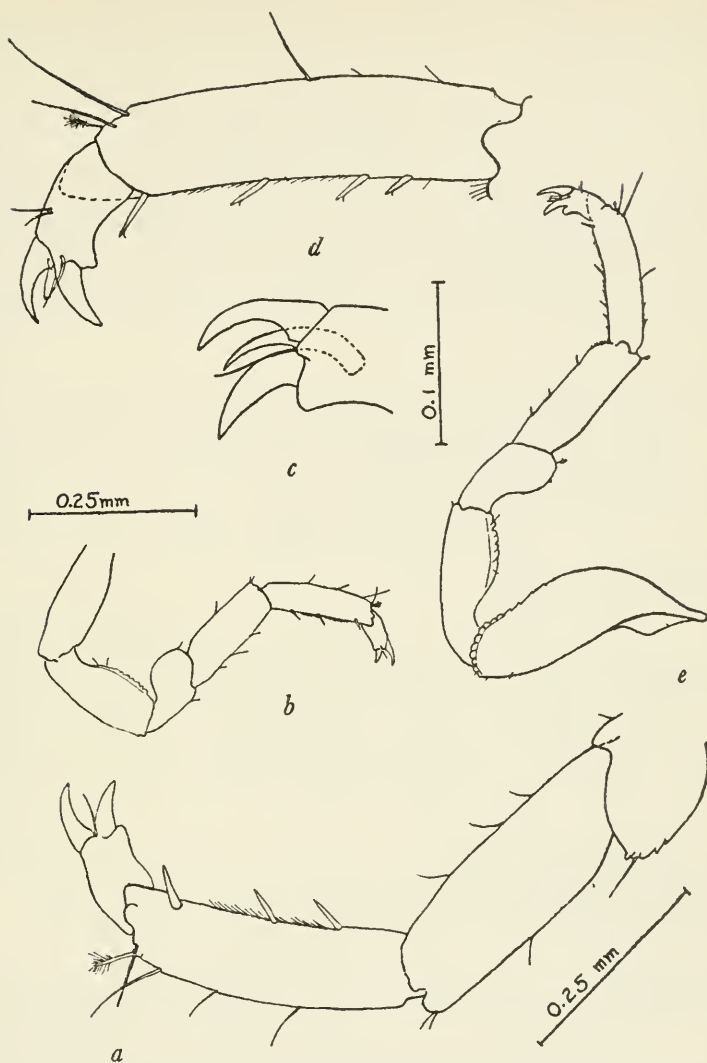


FIGURE 33.—*Jaeropsis dubia*, new species: *a*, Distal joints of right first peraeopod, female paratype; *b*, right first peraeopod, female paratype; *c*, dactylus of seventh peraeopod; *d*, distal joints of seventh peraeopod, female paratype; *e*, seventh peraeopod, female paratype. (Magnification as indicated by scales: *d* same as *a*; *e* same as *b*.)

*Material examined*.—Specimens were examined that had been collected from the following California localities:

MARIN COUNTY: *Dillon Beach*, Second Sled Road, August 14, 1947 (R. J. M.), 2 males; December 10, 1947 (R. J. M.), holotype and allotype; February 21, 1948 (R. J. M.), 2 males, 2 females; March 22, 1948 (R. J. M.), 1 male, 4 females; March 28, 1948 (R. J. M.), 1 male (albino); May 12, 1948 (R. J. M.), 6 males, 9 females, 2 ovigerous; *Tomales Point*, *Tomales Bluff*, ocean side, August 18, 1947 (R. J. M.),

2 females, 1 ovigerous; May 23, 1948 (R. J. M.), 1 male, 1 female; Tomales Bluff, bay side, November 28, 1947 (R. J. M.), 1 male, 2 females; November 30, 1947 (R. J. M.), 1 male, 2 females; May 23, 1948 (R. J. M.), 4 males, 14 females, 3 ovigerous; *Duxbury Reef*, August 15, 1947 (R. J. M.), 1 male. MONTEREY COUNTY<sup>11</sup>: *Carmel Cove*, July 18, 1947 (T. R. Howell), 1 ovigerous female; *Asilomar*, July 16, 1947, Cadet Hand, 1 ovigerous female; *Point Pinos*, July 3, 1947 (W. Fox, V. House, and L. Kellen), 1 male, 1 female; *Pescadero Point*, July 8, 1947 (D. P. Abbott), 1 male. ORANGE COUNTY<sup>12</sup>: *Newport Bay*, November 15, 1933 (G. E. MacGinitie), on boat bottom, 1 male.

*Ecology*.—Specimens were collected most frequently from the lowest exposed areas (zone 4) of the exposed rocky coast localities. They were found on the algal holdfasts *Egrecia*, *Laminaria*, and *Macrocystis*; on the bryozoans *Costazia costazi*, *Filicrisia* sp., and *Tricellaria occidentalis*; on the tunicates *Amaroucium californicum* and *Synoiicum* sp., as well as on hydroids and barnacles and under rocks in the intertidal zones 3 and 4.

*Remarks*.—This species certainly appears to be closely related to *Jaeropsis lobata* Richardson. It differs from *J. lobata* in having stout spines on the lateral borders of the pleotelson, a fringe of scales on the outer margin of the rostral process and similar scales on certain joints of the antennae and pereopods. At my request Dr. Fenner A. Chace, Jr., curator of marine invertebrates, U. S. National Museum, kindly examined the type of *J. lobata* to discern whether the structures mentioned above were present. Dr. Chace writes, "The type of that species, so far as I am able to make out, lacks the spines on the pleotelson and the fringed scales on the frontal lamina. Both of these margins appear to be perfectly entire."

There seems to exist a definite correlation between the amount of dark pigment on the body and the number of spines on the pleotelson. Albino specimens of *J. dubia* had seven spines on each side of the pleotelson; other specimens having pigments concentrated on the head but few pigments elsewhere had five to six spines on either side of the pleotelson. The var. *paucispinis*, described below, in which more pigments are present, has from two to three spines on either side of the pleotelson. Richardson's *J. lobata*, a species having more pigment than any I have examined, lacks spines on the pleotelson lateral borders. Although the correlation between the number of pleotelson spines and the amount of body pigment might indicate that *J. dubia* is not distinct from *J. lobata*, other differences as enumerated above

<sup>11</sup> Specimens lent to writer by Dr. Frank A. Pitelka, Zoology Department, University of California. Paratypes donated to U. S. National Museum.

<sup>12</sup> Specimen lent to writer by Dr. Fenner A. Chace, Jr., curator of marine invertebrates, U. S. National Museum.



seem to warrant specific separation of the two, at least until definite intermediate stages can be found.

**JAEROPSIS DUBIA PAUCISPINIS, new variety**

FIGURE 30, *a, c*

A number of specimens having a cephalon color pattern similar to that shown in figure 30, *c*, three spines on each lateral pleotelson border, as shown in figure 30, *a*, and a heavily pigmented fourth pereaeon segment, might be considered as representing a distinct variety of *J. dubia*. In all other respects the specimens are identical with *J. dubia*.

One specimen having two spines on each pleotelson lateral border and a black middorsal line on the perion with the remainder of the body white, appears closely related to the *paucispinis* variety.

Specimens of the *paucispinis* variety were not infrequently collected with specimens of *J. dubia* at localities around Dillon Beach and Tomales Point, Marin County, Calif.

*Types*.—Holotype and allotype collected at Dillon Beach, Marin County, Calif., May 12, 1948, by R. J. Menzies. Type material has been deposited as follows:

United States National Museum, holotype male, No. 87711; allotype, No. 87710; paratype male, No. 89055. Pacific Marine Station, 4 males and 1 female paratypes, accession Nos. 1240–1242 Arth.

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THE HELMINTH PARASITES OF BIRDS, III:  
DICROCOELIID TREMATODES FROM  
NORTH AMERICAN BIRDS

By J. FRED DENTON and ELON E. BYRD

DURING the past several years we have examined, for helminth parasites, more than 700 specimens of wild birds, which represent 14 orders, 40 families, and 134 species. Although the avian hosts came from various localities throughout the southeastern section of the United States, the greater concentrations were collected from State College, Miss.; Athens and Augusta, Ga.; Highlands, N. C.; Reelfoot Lake, Tenn.; Eagle Lake and Houston, Tex.; and Mountain Lake, Va.

In the present paper only those trematodes belonging to the subfamily *Dicrocoeliinae* Looss, 1899, that were studied by us personally are considered in detail. We collected the greater part of the material included in this study, although we have been fortunate in obtaining specimens of several of the species from other investigators.<sup>1</sup>

<sup>1</sup> For the loan of specimens of several species from outside the area covered the writers wish to thank Dr. Paul D. Harwood for material from Tennessee, Dr. Donald V. Moore for material from Texas, Dr. Robert Rausch for specimens from Ohio and Michigan, and Dr. F. G. Wallace for specimens of species collected by Ishii in Minnesota.

The senior author expresses his appreciation to Prof. Asa C. Chandler, Rice Institute, Houston, Tex., under whose direction this study was begun, for many valuable aids and suggestions. The junior author acknowledges his indebtedness to the Graduate School, University of Georgia, Athens, Ga.; the University Center, Atlanta, Ga.; the Mountain Lake Biological Station, Mountain Lake, Va.; and The Minnie D. Warren Fellowship, Highlands Museum and Biological Laboratory, Highlands, N. C., for financial assistance in making this study possible.

Genus **LYPEROSOMUM** Looss, 1899**LYPEROSOMUM OSWALDOI** (Travassos, 1919)FIGURE 35, *a-c*

*Oswaldoia oswaldoi* TRAVASSOS, Arch. Esc. Sup. Agr., vol. 3 (1919), pp. 15-17, fig. 6, 1920.

*Lyperosomum oswaldoi* TRAVASSOS, Monogr. Inst. Oswaldo Cruz, No. 2, pp. 141-145, est. 47, figs. 1-5; est. 48, figs. 1-5; est. 49, fig. 1, 1944.

*Description*.—Body of sexually mature specimens (fig. 35, *a, b*) elongated, slender, 4.35 to 10.65 mm. long by 0.39 to 0.77 mm. wide in testicular zone, semitransparent, slightly flattened dorsoventrally; preacetabular region short, narrowing abruptly to blunt anterior extremity; postacetabular segment extremely elongated, gradually tapering to rounded posterior end. Cuticle aspinose, with fine transverse striations and small retractile sensory papillae, which are usually more clearly visible along margins of body of living specimens. Oral sucker subterminal, 0.15 to 0.30 mm. long by 0.16 to 0.31 mm. wide, preceded dorsally by a short liplike projection. Acetabulum large, 0.37 to 0.66 mm. in diameter, strongly muscular, cup-shaped with a deep lumen (fig. 35, *b*), located within anterior seventh of body. Ratio of width of oral sucker to acetabulum about 1:2. Pharynx globular, relatively small, 0.06 to 0.15 mm. in diameter. Length of esophagus approximately equal to diameter of pharynx. Ceca slender, slightly sinuous, unequal in length, terminating one-half to two-thirds distance from vitellaria to caudal extremity of body. Excretory pore terminal. Excretory vesicle thin-walled, tubular, extending anteriad almost to seminal receptacle, where it receives a common collecting tubule from each side of body. Common collecting tubules passing anteriad laterally to gonads to zone of posterior third of acetabulum, where each branches into an anterior and posterior main collecting tubule. Genital pore approximately median, at level of posterior limits of pharynx. Testes round to oval, 0.11 to 0.30 mm. long by 0.13 to 0.36 mm. wide, oblique in position, located close behind acetabulum, in anterior fourth of body. Anterior testis may be on right or left side of body midline. Cirrus sac club-shaped, small, 0.07 to 0.19 mm. long by 0.04 to 0.10 mm. wide, usually lying entirely in front of acetabulum, containing convoluted seminal vesicle, ejaculatory duct surrounded by prostatic gland cells and eversible cirrus. Ovary round to transversely oval, 0.07 to 0.27 mm. long by 0.13 to 0.31 mm. wide, situated from 0.10 to 0.35 mm. behind caudal testis and on same side of body as that organ. Seminal receptacle globular, located just posterior to ovary. Mehlis' gland at posteromedial margin of seminal receptacle. Vitellaria lateral in position, composed of numerous small follicles, beginning anteriorly at a level within zone of anterior testis and extending posteriorly for a distance of 1.85 to 4.34 mm., terminating



at a level approximately midway between acetabulum and posterior end of body. Vitelline ducts emerging from yolk glands at a level one-third to one-half their length from anterior limits, uniting in median plane of body to form common vitelline duct. Uterus greatly convoluted, filling most of body behind ovary, passing anteriorly on right or left side of ovary and posterior testis, between testes, dorsal to acetabulum and cirrus sac, terminating in a weakly muscular metraterm. Metraterm equal in length in cirrus sac. Ova numerous, dark brown when mature, measuring  $26\mu$  to  $33\mu$  long by  $18\mu$  to  $22\mu$  wide. Ciliated miracidium possessing a stylet and two large oval, oppositely situated vesicles which are filled with refractile granules.

*Additional hosts.*—*Toxostoma rufum* (Linnaeus) and *Cyanocitta cristata* (Linnaeus).

*Habitat.*—Liver and gall bladder.

*Localities.*—GEORGIA: Augusta and Athens; MISSISSIPPI: State College; TEXAS: Houston and Eagle Lake.

*Material.*—Specimens No. 36749, 36750, 36751, and 36794 have been deposited in the helminthological collection of the United States National Museum.

*Remarks.*—*Lyperosomum oswaldoi* is described here from numerous specimens from the liver and gall bladder of the brown thrasher, *Toxostoma rufum*, and two specimens from the gall bladder of the blue jay, *Cyanocitta cristata*, from the southern United States. The parasite is common in the brown thrasher, being recorded from 20 (48.8 percent) of 41 specimens of this species examined to date. The blue jay, on the other hand, must be considered as a rare or accidental host for the species, since only a single specimen (3.8 percent) of 26 birds proved to carry the form in its gall bladder. However, the parasite in the blue jay was normal in every way and was fully gravid. The specimens from the blue jay were indistinguishable from those in the brown thrasher.

*Lyperosomum oswaldoi* apparently represents the New World counterpart of *L. longicauda* (Rudolphi, 1809), from birds of the Old World. In Europe *L. longicauda* appears to be confined to birds of the family Corvidae (crows and jays), while *L. oswaldoi* has been recorded from birds of the families Thraupidae (tanagers), Icteridae (blackbirds), Phasianidae (partridges), and Fringillidae (sparrows) in South America and from species of Mimidae (thrashers) and Corvidae in North America (present paper). The two species, *L. longicauda* and *L. oswaldoi*, have the same general body appearance and internal organization but show certain minor differences. The body and internal organs, with the exception of the ova which are considerably larger, are smaller in *L. oswaldoi* than in *L. longicauda*. Very probably *L. oswaldoi* will fall as a synonym of *L. longicauda* (*sensu*

*stricto*) when the latter is more completely described. At the present time, however, we feel justified in regarding the two forms as distinct.

While comparing *L. oswaldoi* with other closely related forms of the genus *Lyperosomum*, it has been made clear to us that *L. skrjabini* (Solowiow, 1911), described from the same hosts as *L. longicauda*, must be considered a direct synonym of the latter. Further, it is our opinion that *L. urocissae* Yamaguti, 1939, is a synonym of *L. oswaldoi*.

### Genus LUTZTREMA Travassos, 1941

#### LUTZTREMA MONENTERON (Price and McIntosh, 1935)

##### FIGURE 34, a-d

*Lyperosomum monenteron* PRICE and MCINTOSH, Proc. Helm. Soc. Washington, vol. 2, pp. 63-64, fig. 12, 1935.

*Lutztrema monenteron* TRAVASSOS, Mem. Inst. Oswaldo Cruz, vol. 36, pp. 336-338, 1941.

The material in the present collection agrees very closely with that described by Price and McIntosh (1935). The present study has brought out several features that might be of aid in recognizing the species as being separate and distinct from its closest relative, *L. obliquum* (Travassos, 1917). These features only will be considered. The body of the relaxed specimen (fig. 34, a) is widest in the region of the anterior testis; it tapers gradually from this point toward both ends. Although aspinose, the cuticle usually exhibits fine transverse ridges over most of the body while small, conical, retractile sensory papillae appear on the surface of the oral sucker and along the margins of the preacetabular region of the body; these papillae are readily observed on living worms. The acetabulum (fig. 34, b) is strongly muscular and cup-shaped with a deep lumen; it is usually set in the bottom of an acetabular depression. The ratio of the width of the oral sucker to acetabulum varies from 1:1.65 to 1:2. The cecum passes between the testes and between the posterior testis and ovary, and without exception terminates well in advance of the posterior end of the body, usually terminating anywhere from just posterior to the vitellaria to a point about one-third the distance from the vitellaria to the posterior end of the body. The common collecting tubules of the excretory system arise from the anterior end of the excretory vesicle and pass anterolaterally to a level midway between the testicular zones where they divide into anterior and posterior main collecting tubules. Each of the main collecting tubules gives rise to three short accessory tubules, each of which branches into two capillaries. Each capillary tubule terminates in a single flame cell, thus establishing a

2 [(2+2+2)+(2+2+2)] flame cell pattern. The vasa efferentia arise from the dorsomedial surfaces of the testes and unite midway between the anterior testis and acetabulum to form a long vas deferens,



FIGURE 34.—a, *Lutztrema monenteron* (Price and McIntosh, 1935) from the gall bladder of *Turdus migratorius*, ventral view; b, optical sagittal section of anterior end of *Lutztrema monenteron* from *Turdus migratorius*, showing ventral flexure of anterior end and the position and deep lumen of the acetabulum; c, *Lutztrema monenteron* from the gall bladder of *Mimus polyglottos*, ventral view; d, *Lutztrema monenteron* from the gall bladder of *Toxostoma rufum*, ventral view, specimen slightly shrunken; e, *Lutztrema microstomum*, new species, from the gall bladder of *Cyanocitta cristata*, ventral view; f, optical sagittal section of anterior end of *Lutztrema microstomum* from *Cyanocitta cristata*, showing position of suckers and deep lumen of acetabulum.



which parallels the course of the cecum to the cirrus sac. The transversely oval testes frequently show a distinct indentation of their lateral margins. The number of vitelline follicles varies from 8 to 14 on each side of the body. Anterior to the level of the ovary the uterus follows the course of the cecum in ascending to the genital pore. The mature ova,  $30\mu$  to  $34\mu$  by  $17\mu$  to  $21\mu$ , contain ciliated, styleded miracidia, each with two large, oval, refractile vesicles.

*Lutztrema monenteron* has been reported previously by Price and McIntosh (1935) from the gall bladder and bile ducts of the robin, *Turdus migratorius* Linnaeus, and the bluebird, *Sialia sialis sialis* (Linnaeus), from Washington, D. C., Virginia, and Quebec, Canada, and by Ishii (1942) from the liver of the ruffed grouse, *Bonasa umbellus* (Linnaeus), and the kingbird, *Tyrannus tyrannus* (Linnaeus), from Minnesota. Through the kindness of Dr. E. G. Wallace, University of Minnesota, we have been permitted to examine slides numbered G-33-19, G-36-6 (ruffed grouse) and G-36-7, G-36-8 (kingbird) of Ishii's material. Since the mounted specimens of this material prove to be entirely unsuitable for study it is impossible for us to verify Ishii's identification. The species from the ruffed grouse and kingbird, then, must remain as *species inquirenda* awaiting further study on more favorable material.

The present paper reports specimens of *L. monenteron* from the liver of the robin, *Turdus migratorius*, from Mountain Lake, Va.; Highlands, N. C.; Augusta, Ga.; Nashville, Tenn.; Houston, Tex.; and Marion, Ohio. Fourteen (73.7 percent) of the 19 robins examined by us proved to have flukes of this species in the gall bladder and bile ducts. In addition to the material from the robin, specimens identified as *L. monenteron* were taken from the gall bladder of two (10 percent) of 20 mockingbirds, *Mimus polyglottos* (Linnaeus), from Augusta, Ga., and Houston, Tex., and from a single (2.4 percent) brown thrasher, *Toxostoma rufum* (Linnaeus), from Mountain Lake, Va. Although the specimens from the mockingbird (fig. 34, *c*) and brown thrasher (fig. 34, *d*) are slightly smaller, they agree very closely with the form from the robin in (1) shape of the body; (2) ratio of sucker sizes and position of the acetabulum; (3) course and length of the cecum; (4) shape and position of the genital organs; (5) position of the genital pore; and (6) pattern of the uterus in front of the anterior testis. In certain of the specimens from the mockingbird the ova measure as much as  $39\mu$  in length, while in other specimens from the same host they fall within the range given for the ova from the robin material. Further evidence that the worm from the mockingbird is identical with the form in the robin is obtained through life-history studies; the larval stages of the two forms are indistinguishable (unpublished data).



Specimens No. 36759 and 36760 from the robin, No. 37114 from the mockingbird, and No. 37113 from the brown thrasher have been deposited in the helminthological collection of the United States National Museum.

We agree with Travassos (1944) in considering *L. monenteron* to be very closely related to *L. obliquum* (Travassos, 1917). The two forms, however, can be distinguished readily by the length of the cecum. In all the present specimens the cecum terminates well in advance of the posterior end of the body, usually at the junction of the middle and posterior body thirds, while in *L. obliquum* it terminates just short of the posterior end. There is also a slight but consistent difference in the size of the eggs. Since the North American hosts of *L. monenteron*, with the exception of the kingbird (reported by Ishii), are all nonmigratory birds or species in which migration is confined to movements within the continent, and since certain definite anatomical differences are observed, we are of the opinion that *L. monenteron* and *L. obliquum* should be retained as separate species until more is known concerning the life history and geographic distribution of the two forms.

LUZTREMA MICROSTOMUM, new species

FIGURE 34, e, f

*Diagnosis.*—Body of sexually mature specimens (fig. 34, e) semi-transparent, elongated-slender, 3.00 to 4.95 mm. long by 0.19 to 0.46 mm. wide in region of vitellaria, tapering abruptly in preacetabular region and more gradually toward posterior end. Cuticle thin, aspinose, with small conical, retractile, sensory papillae visible on lateral margins of preacetabular region. Oral sucker subterminal, small, 0.07 to 0.13 mm. in diameter, preceded dorsally by a prominent liplike projection. Acetabulum relatively large, 0.14 to 0.23 mm. in diameter, muscular, cup-shaped with fairly deep lumen (fig. 34, f), situated about one-tenth of body length from anterior end. Ratio of diameter of oral sucker to acetabulum 1:1.75 to 1:2.80. Pharynx slightly wider than long, measuring 0.03 to 0.05 mm. long by 0.03 to 0.06 mm. wide. Esophagus very thin-walled, slender, approximately 0.14 mm. long. Cecum slender and thin-walled, passing either to right or left of anterior testis, between testes, and between posterior testis and ovary, then continuing posteriorly in more or less wide undulations to near body middle, where it terminates. Excretory pore terminal. Excretory vesicle thin-walled, narrow, tubular, extending anteriorly to level of anterior limits of vitellaria, where it receives two common collecting tubules. Each common collecting tubule receives an anterior and posterior main collecting tubule at level of intertesticular zone. Genital pore median, located approximately midway

between suckers. Testes rounded to transversely oval, 0.11 to 0.26 mm. long by 0.12 to 0.31 mm. wide, situated slightly obliquely in anterior third of body with zone of posterior testes entirely behind that of anterior, a relative position retained even in greatly contracted specimens. Vasa efferentia arising from dorsomedial surfaces of testes, uniting just in front of anterior testis to form a long vas deferens. Cirrus sac elongated-pyriform, 0.12 to 0.16 mm. long by 0.06 to 0.07 mm. wide, containing a coiled seminal vesicle, ejaculatory duct surrounded by prostatic gland cells and a cirrus, which is usually observed to be partly everted in preserved specimens. Cirrus sac usually contiguous with anterior margin of acetabulum. Ovary transversely oval, 0.08 to 0.15 mm. long by 0.08 to 0.18 mm. wide, submedial in position close behind posterior testis. Seminal receptacle large, globular, posterior to caudal margin of ovary. Mehlis' gland located immediately posterior to seminal receptacle. Laurer's canal opening to outside dorsally to posterior third of ovary. Vitellaria composed of 8 to 15 large, oval follicles on each side of body, tending to fuse in median line anteriorly, located just posterior to seminal receptacle. Vitelline ducts arising from anterior vitelline follicles and uniting medianly to form common yolk reservoir. Uterus much convoluted, filling most of body posterior to ovary, usually following course of cecum in ascending, sometimes leaving cecum to ascend on same side of ovary and posterior testis. Uterus describing several, usually 3 to 6, lateral loops between anterior testis and acetabulum before ascending to genital pore. Metraterm weakly muscular, equal in length to cirrus sac. Mature ova dark brown,  $29\mu$  to  $35\mu$  long by  $19\mu$  to  $24\mu$  wide, fully embryonated when oviposited.

*Host*.—*Cyanocitta cristata* (Linnaeus).

*Habitat*.—Liver and gall bladder.

*Localities*.—TEXAS: Houston (type); GEORGIA: Augusta; and NORTH CAROLINA: Highlands.

*Molluscan hosts*.—*Bulimulus alternatus mariae* (Albers), *Deroceras reticulatum* (Müller), and *Deroceras laeve* (Müller).

*Type specimen*.—U. S. N. M. Helm. Coll. No. 36761. Additional specimen, No. 36769.

*Remarks*.—*Lutztrema microstomum* is recorded only from the blue jay *Cyanocitta cristata*. Seven (27 percent) of the 26 specimens of this host examined harbored from 1 to over 200 worms (average 42 per bird). *Lutztrema microstomum* can be separated from *L. monenteron*, the only other member of the genus thus far encountered from birds in the United States, by its smaller and much narrower body, its relatively larger and more anteriorly situated acetabulum, its relatively shorter cecum, its more tandem testes, the greater distance between the acetabulum and testes, and the pattern of the uterus in front of the anterior testis.

## Genus BRACHYLECITHUM Strom, 1940

## BRACHYLECITHUM RARUM (Travassos, 1917)

FIGURE 35, *d*, *e*

*Lyperosomum rarum* TRAVASSOS, First Conf. Soc. Sud. Amer. Hig., pp. 738, 741-742, fig. 4 (1916), 1917.

*Brachylecithum rarum* STROM, Parasitol. Sborn. Zool. Inst. Akad. Nauk U.S.S.R., vol. 8, p. 183, 1940.

*Olsoniella rara* TRAVASSOS, Monogr. Inst. Oswaldo Cruz, No. 2, pp. 217-218, est. 84, figs. 1-3; est. 85, figs. 1-2, 1944.

*Description*.—Body of mature specimens large and robust, 4.50 to 6.90 mm. long by 0.30 to 0.49 mm. wide between acetabulum and vitellaria, slightly flattened dorsoventrally, with almost parallel sides and rounded ends. Cuticle aspinose, but with prominent fingerlike tuberculations irregularly distributed over body except for region anterior to genital pore. Oral sucker subterminal in position, large and muscular, 0.28 to 0.38 mm. long by 0.28 to 0.31 mm. wide. Acetabulum weakly muscular, 0.29 to 0.35 mm. long by 0.29 to 0.41 mm. wide, with shallow, saucerlike lumen in living or relaxed specimens, or with center protruded (fig. 35, *e*) so as to eliminate lumen in most fixed specimens, located in anterior sixth of body. Ratio of width of oral sucker to acetabulum 1:1.05 to 1:1.34. Prepharynx absent. Pharynx muscular, globular, longer than wide, 0.09 to 0.11 mm. long by 0.08 to 0.10 mm. wide. Esophagus slender, straight to slightly wavy, bifurcating from one-half to three-fourths of distance from oral sucker to acetabulum. Ceca of medium width, fairly thick-walled, straight to slightly wavy, passing dorsal to acetabulum, dorsal to lateral margins of gonads and dorsal to vitellaria, terminating unevenly near body middle, with ends forming distended pouches. Excretory pore terminal. Excretory vesicle thin-walled, tubular, extending anteriorly to near anterior limits of vitellaria. Genital pore medium, ventral to intestinal bifurcation. Testes round to oval, equal in size, 0.17 to 0.32 mm. in diameter, situated in body midline, with one directly behind the other. Anterior testis separated from acetabulum by three to six transverse loops of uterus; posterior testis usually separated from anterior one by a single dorsoventral loop of uterus. Vasa efferentia arising from dorsomedial surfaces of testes and uniting just posterior to caudal margin of acetabulum to form an almost straight vas deferens. Cirrus sac elongated-pyriform, 0.18 to 0.25 mm. long by 0.07 to 0.10 mm. wide, containing a coiled seminal vesicle, ejaculatory duct surrounded by prostatic gland cells and eversible cirrus. One-third to one-half of cirrus sac lies dorsally to acetabulum. Ovary transversely oval in shape, 0.11 to 0.18 mm. long by 0.14 to 0.21 mm. wide, situated in middle of body and separated from posterior testis by one to

four transverse loops of uterus. Seminal receptacle small, globular, situated entirely posterior to ovary. Mehli's gland diffuse, located

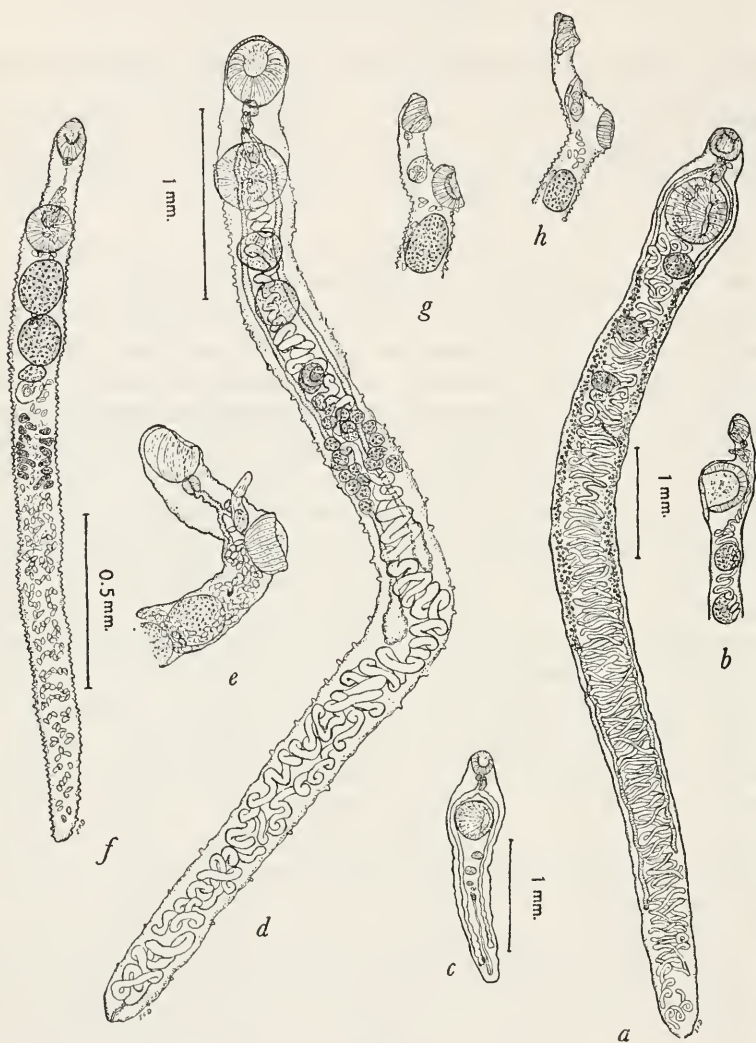


FIGURE 35.—a, Adult *Lyperosomum oswaldoi* (Travassos, 1919) from the gall bladder of *Toxostoma rufum*, ventral view; b, optical sagittal section of anterior end of *Lyperosomum oswaldoi* from *Toxostoma rufum*, showing position and lumen of acetabulum; c, very young specimen of *Lyperosomum oswaldoi* removed from the gall bladder of *Toxostoma rufum*, showing similarity in shape and arrangement of organs to that of adult; d, *Brachylecithum rarum* (Travassos, 1917) from the liver of *Pipilo erythrophthalmus*, ventral view; e, lateral view of anterior end of *Brachylecithum rarum* from *Pipilo erythrophthalmus*, showing position of suckers and protruding center of acetabulum; f, *Brachylecithum tuberculatum*, new species, from the liver of *Wilsonia canadensis*, ventral view; g, h, lateral views of anterior ends of *Brachylecithum tuberculatum* from *Wilsonia canadensis*, showing acetabulum with shallow lumen and with center protruded.



posteromedial to seminal receptacle. Laurer's canal not observed. Vitellaria consisting of 7 to 14 large oval to rounded, discrete follicles on each side of body, tending to meet ventrally at anterior limits and occupying zone immediately posterior to Mehlis' gland. Uterus much convoluted, filling most of body posterior to vitellaria, then passing forward ventrally to vitellaria and ovary (in two specimens the uterus passes dorsally to the ovary) by undulating course, dorsally between ovary and posterior testis, dorsally to both testes and acetabulum to genital pore. Mature ova dark brown, fully embryonated when oviposited,  $44\mu$  to  $57\mu$  long by  $23\mu$  to  $33\mu$  wide.

*Additional host.*—*Pipilo erythrophthalmus* (Linnaeus).

*Habitat.*—Liver and bile ducts.

*Localities.*—VIRGINIA: Mountain Lake; NORTH CAROLINA: Highlands.

*Material.*—Two specimens have been deposited in the helminthological collection of the U. S. National Museum, No. 37115.

*Remarks.*—*Brachylecithum rarum* is described here from 25 mature specimens from the liver of the red-eyed towhee, *Pipilo erythrophthalmus*, from Mountain Lake, Va., and Highlands, N. C. The material in the present collection agrees very closely with that described by Travassos (1917, 1944) except for the size of the pharynx, which is slightly larger in our material.

#### BRACHYLECITHUM TUBERCULATUM, new species

FIGURE 35, *f-h*

*Diagnosis.*—Body of mature specimen elongated-cylindrical, with rounded anterior and tapering posterior ends, 1.93 to 3.43 mm. long by 0.17 to 0.20 mm. wide in region of testes. Cuticle aspinose, with numerous close-set conical tuberculations irregularly distributed over body except in region of oral sucker. Oral sucker subterminal, weakly muscular, elongated-oval in shape, 0.11 to 0.18 mm. long by 0.10 to 0.13 mm. wide, with oral opening directed ventrally. Acetabulum weakly muscular, 0.12 to 0.15 mm. in diameter, with shallow saucerlike lumen (fig. 35, *g*) in living and contracted specimens, or with center protruded (fig. 35, *h*), obliterating lumen in most fixed specimens, located in anterior fifth of body. Ratio of width of oral sucker to acetabulum 1:1.18 to 1:1.37. Prepharynx absent. Pharynx muscular, longer than wide, 0.03 to 0.05 mm. long by 0.03 to 0.04 mm. wide. Esophagus very thin-walled, slender, straight to slightly wavy, bifurcating from one-half to two-thirds distance from oral sucker to acetabulum. Ceca narrow, very thin-walled (visible only in sectioned specimens), slightly undulating, passing dorsally to acetabulum, dorsally to margins of testes and dorsally to vitellaria, terminating unevenly just posterior to

last follicles of vitellaria. Excretory pore terminal. Genital pore median, one-half to two-thirds distance from oral sucker to acetabulum, ventral to or slightly anterior to intestinal bifurcation. Testes round to elongated-oval, equal in size, measuring 0.12 to 0.28 mm. long by 0.08 to 0.16 mm. wide, situated one directly behind other, occupying most of width of body. Anterior testis touching acetabulum or separated from it by one or two loops of uterus; posterior testis contiguous with anterior testis. Cirrus sac elongated-pyriform, 0.13 to 0.15 mm. long by 0.05 to 0.06 mm. wide, containing coiled seminal vesicle, ejaculatory duct surrounded by prostatic gland cells and eversible cirrus, from one-third to one-half its length lying dorsally to acetabulum. Ovary round to oval in shape, smaller than testes, 0.05 to 0.10 mm. long by 0.07 to 0.10 mm. wide, located on midline immediately behind posterior testis or separated from that organ by one to three loops of uterus. Seminal receptacle larger than ovary, immediately posterior to ovary. Vitellaria consisting of 8 to 10 medium-sized, ovoid follicles on each side of body, occupying zone posterior to seminal receptacle. Uterus much convoluted, filling body posterior to vitellaria, passing anteriorly between and ventrally to vitellaria, ventrally to middle or to one or other margin of ovary, dorsally between ovary and posterior testis, dorsally to both testes and acetabulum, then following straight or slightly undulating course to genital pore. Metraterm weakly muscular, equal in length to cirrus sac. Mature ova very dark brown, embryonated when oviposited,  $36\mu$  to  $40\mu$  long by  $21\mu$  to  $27\mu$  wide.

*Host*.—*Wilsonia canadensis* (Linnaeus).

*Habitat*.—Liver.

*Locality*.—VIRGINIA: Mountain Lake.

*Type specimen*.—U.S.N.M. Helm. Coll. No. 37117.

*Remarks*.—*Brachylecithum tuberculatum* is described from eight specimens obtained from the liver of two of six Canada warblers, *Wilsonia canadensis*, from Mountain Lake, Va. The species shows a closer affinity to *B. rarum* (Travassos, 1917) than to the other members of the genus in that its body is covered with tuberculations. As compared with this large robust species, *B. tuberculatum* is a small delicate form that possesses differently shaped and more numerous tuberculations, inconspicuous ceca, proportionately larger testes, a different type of vitellaria and a uterus which follows a different course in ascending to the genital pore.

BRACHYLECITHUM NANUM, new species

FIGURE 36, a-d

*Diagnosis*.—Body much elongated-cylindrical, with weakly developed musculature and showing a tendency to be serpentine; it measures 1.85 to 3.39 mm. long by 0.10 to 0.26 mm. wide, widest in

region between acetabulum and vitellaria. Cuticle thin, aspinose, smooth except for small, conical, sensory papillae along margins of suckers and on lateral margins of body in some specimens. Oral sucker subterminal to a small liplike projection, weakly muscular, usually elongate oval in shape, measuring 0.07 to 0.16 mm. long by 0.08 to 0.15 mm. wide. Acetabulum somewhat protrusible, weakly muscular, slightly lemon shaped in frontal view but without prominent auricular appendages, with shallow, saucerlike lumen (fig. 36, *c*) in some specimens or with center protruded (fig. 36, *b*) in others, obliterating lumen; located in anterior body fifth and measuring 0.10 to 0.18 mm. long by 0.11 to 0.20 mm. wide. Ratio of width of oral sucker to acetabulum 1:1.0 to 1:1.4. Prepharynx absent. Pharynx muscular, globular, longer than wide, 0.03 to 0.05 mm. long by 0.03 to 0.04 mm. wide. Esophagus very thin-walled, slender, straight to slightly wavy, relatively long, bifurcating from one-half to two-thirds of distance from oral sucker to acetabulum. Ceca thin-walled, slender, straight to slightly wavy, passing dorsally to acetabulum, dorsally to lateral margins of gonads, dorsally to vitellaria, terminating unevenly as slightly distended tubes from a short distance posterior to vitellaria to midway between vitellaria and posterior end of body. Excretory pore terminal. Genital pore median, ventral to intestinal bifurcation. Testes elongated-oval to kidney-shaped, approximately equal in size, 0.09 to 0.27 mm. long by 0.07 to 0.19 mm. wide, situated one directly behind other and occupying almost entire width of body at their levels; depending on state of constriction of body, anterior testis separated from acetabulum by one to four loops of uterus; posterior testis contiguous to anterior testis or separated from it by a single uterine loop. Cirrus sac elongated-pyriform, 0.12 to 0.16 mm. long by 0.04 to 0.06 mm. wide, containing coiled seminal vesicle, ejaculatory duct, and eversible cirrus, extending posteriorly far enough for one-third to one-half its length to lie dorsally to acetabulum. Ovary oval, 0.05 to 0.12 mm. long by 0.06 to 0.16 mm. wide, situated near middle of body and separated from posterior testis by one to three uterine loops. Seminal receptacle small, globular, situated entirely posterior to ovary, near either margin of body. Mehlis' gland diffuse, located posteromedial to seminal receptacle. Laurer's canal opening on middorsal surface at caudal level of seminal receptacle. Vitellaria consisting of 6 to 10 large oval to irregular follicles on each side of body (sometimes fusing together to form large irregular masses of yolk cells), occupying zone immediately posterior to Mehlis' gland. Uterus greatly convoluted with loops rather indistinct, filling body posterior to vitellaria, then passing anteriorly between and ventrally to vitellaria, ventrally to one margin of ovary, to dorsal side between ovary and posterior testis, dorsally to both testes and acetabulum to

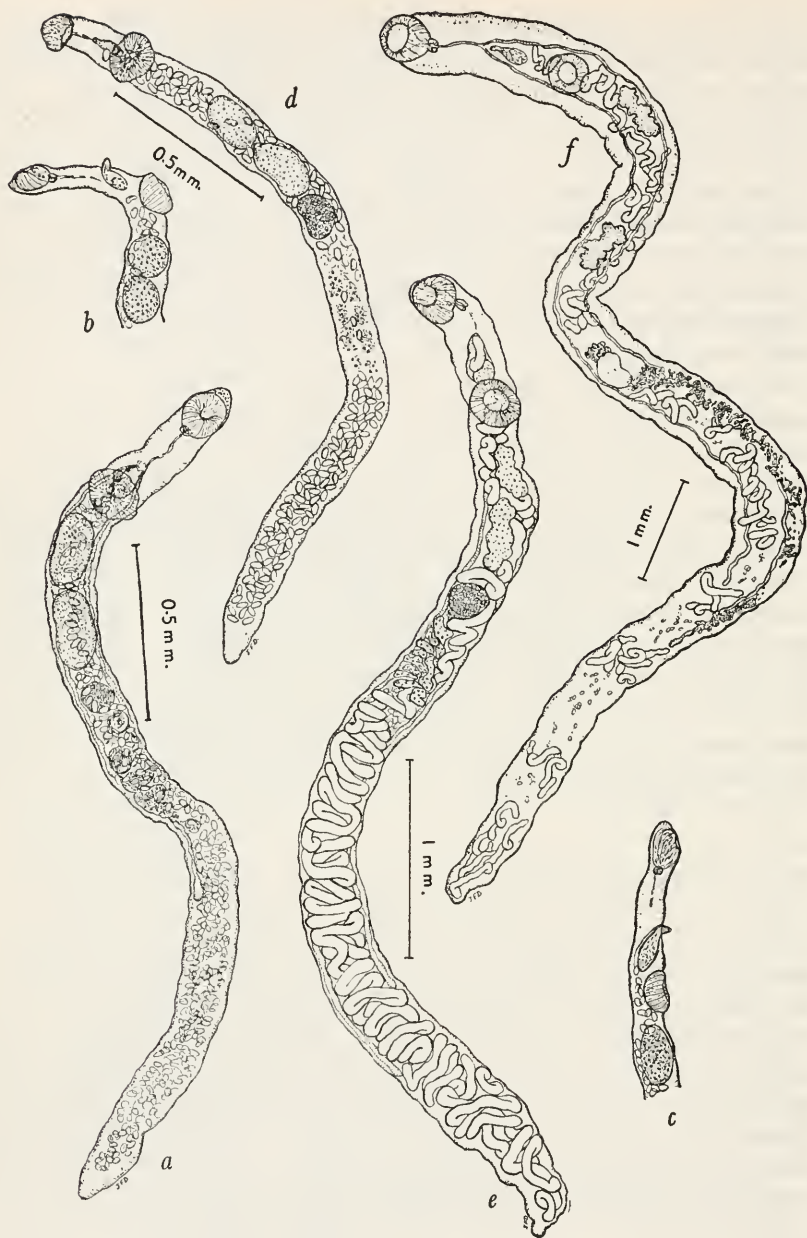


FIGURE 36.—a, *Brachylecithum nanum*, new species, from the liver of *Pipilo erythrophthalmus*, ventral view; b, c, lateral views of anterior ends of *Brachylecithum nanum* from *Pipilo erythrophthalmus*, showing acetabulum with center protruded and with shallow lumen; d, *Brachylecithum nanum* from the liver of *Zonotrichia albicollis*, ventral view; e, *Brachylecithum gruis*, new species, from the liver of *Grus canadensis tabida*, ventral view (drawing made from camera lucida sketches of parts of three worms); f, *Athesmia heterolecithodes* (Braun, 1899) from the liver of *Gallinula chloropus cachinnans*, dorsal view.



genital pore. Mature ova dark brown,  $38\mu$  to  $48\mu$  long by  $21\mu$  to  $28\mu$  wide, fully embryonated when oviposited.

*Hosts*.—*Pipilo erythrophthalmus* (Linnaeus) (type) and *Zonotrichia albicollis* (Gmelin).

*Habitat*.—Liver.

*Localities*.—NORTH CAROLINA: Highlands (type); VIRGINIA: Mountain Lake; GEORGIA: Athens and Augusta; TEXAS: Houston.

*Type specimen*: U.S.N.M. Helm. Coll. No. 37116. Additional specimen, No. 36758, from the white-throated sparrow.

*Remarks*.—*Brachylecithum nanum* is described from specimens from the livers of 9 (27.3 percent) of 33 red-eyed towhees, *Pipilo erythrophthalmus*, collected at Highlands, N. C., and Mountain Lake, Va., and from 4 (12.9 percent) of 31 white-throated sparrows, *Zonotrichia albicollis*, collected in Georgia and Texas. Because of their delicate structure and the difficulty with which they are extracted, many specimens were broken during removal. Other specimens, because of a tendency to rotate a part of the body, are poor for detailed study. The species shows a close relationship to no less than five of the already described forms: *B. filliforme* (Skrjabin, 1913), *B. megastoma* (Johnston, 1917), *B. vanellicolae* (Layman, 1922), *B. loossi* (Layman, 1926), and *B. asovi* (Layman, 1926). Of these only *B. filliforme* is described and figured in sufficient details to permit comparison with *B. nanum*. From it *B. nanum* differs in being smaller and in having relatively larger suckers, relatively larger testes, and a much smaller cirrus sac. The type material of *B. filliforme* came from the gall bladder of a hawk, *Circus cyaneus*.

#### BRACHYLECITHUM GRUIS, new species

##### FIGURE 36, e

*Diagnosis*.—Body thin and semitransparent, greatly elongated, tapering gradually at posterior end, measuring approximately 5.24 mm. long by 0.26 to 0.30 mm. wide at acetabulum. Cuticle without spines or other obvious markings. Oral sucker subterminal, weakly muscular, 0.25 mm. long by 0.23 mm. wide. Acetabulum weakly muscular, approximately equal in size to oral sucker, 0.18 to 0.28 mm. in diameter, within anterior sixth of body. Pharynx globular, 0.09 mm. in diameter. Esophagus narrow, thin-walled, about twice as long as pharynx, bifurcating approximately midway between suckers. Ceca slender, slightly wavy, passing laterally to gonads to terminate about two-thirds the distance from vitellaria to posterior end of body. Excretory pore terminal. Genital pore median at intestinal bifurcation. Testes distinctly lobed, approximately equal in size, 0.26 to 0.41 mm. long by 0.14 to 0.19 mm. wide: anterior testis separated from

acetabulum by two or three lateral loops of uterus; posterior testis entirely behind anterior one. Cirrus sac elongated-oval, 0.15 to 0.27 mm. long by 0.07 to 0.11 mm. wide, containing much convoluted seminal vesicle, ejaculatory duct and eversible cirrus. Ovary oval, 0.13 to 0.24 mm. long by 0.12 to 0.23 mm. wide, slightly submedially in position. Seminal receptacle globular, dorsal to caudal margin of ovary. Vitellaria consisting of 10 to 12 large irregular follicles on each side of body, in anterior half of body, just caudal to seminal receptacle. Uterus greatly convoluted in descending and ascending, filling most of postovarial portion of body, then passing anteriorly to left of ovary and posterior testis and between testes to genital pore. Mature ova dark brown,  $36\mu$  to  $42\mu$  long by  $22\mu$  to  $23\mu$  wide.

*Host*.—*Grus canadensis tabida* (Peters).

*Habitat*.—Liver.

*Locality*.—TEXAS: Clodine.

*Type material*.—U. S. N. M. Helm. Coll. No. 36757.

*Remarks*.—*Brachylecithum gruis* is described from pieces of seven worms from the livers of two sandhill cranes, *Grus canadensis tabida*. These birds died of a limberneck disease occurring in wintering birds in the vicinity of Clodine, Tex., during January 1940. Only fragments of the worm were available for study, although one nearly complete worm is included in the collection.

*Brachylecithum gruis* has an elongated, serpentine body and suckers of approximately equal size, which, together with the elongated, distinctly lobed testes situated one entirely behind the other and a relatively large oval ovary, distinguish it from other species of the genus.

BRACHYLECITHUM SEIURICUM, new species

FIGURE 37, a-f

*Diagnosis*.—Body flattened dorsoventrally, elongated, 1.79 to 2.37 mm. long by 0.18 to 0.29 mm. wide in region between anterior testis and vitellaria, with almost parallel sides and rounded or slightly tapering extremities. Musculature of body weakly developed. Cuticle thin, aspinose, with fine transverse ridges. Small sensory papillae on margins of body in some specimens. Oral sucker subterminal to inconspicuous liplike protuberance, weakly muscular, 0.11 to 0.14 mm. in diameter. Acetabulum weakly muscular, protrusible, 0.14 to 0.19 mm. in diameter, with shallow saucerlike lumen or with center protruded far enough to obliterate lumen (fig. 37, b) in anterior fourth of body. Ratio of diameter of oral sucker to acetabulum 1:1.2 to 1.5. Prepharynx absent. Pharynx muscular, globular, relatively small, approximately 0.03 mm. in diameter. Esophagus very thin-walled, slender, approximately 0.19 to 0.20 mm. long, bifurcating just in front of or dorsal to cephalic margin of acetabulum. Ceca thin-walled, dif-

ficult to visualize in fixed specimens, of medium width, straight to slightly wavy, terminating unevenly just in front of vitellaria or somewhere within vitelline zone. Excretory pore terminal. Genital pore median, anterior to bifurcation of intestine, from one-half to three-fourths the distance from oral sucker to acetabulum. Testes approximately equal in size, 0.06 to 0.18 mm. long by 0.07 to 0.15 mm. wide, round to oval, with smooth to slightly lobed margins, slightly oblique in position. Anterior testis immediately posterior to acetabulum or depending on state of contraction of body, may be separated from that organ by one to three uterine loops. Posterior testis entirely behind zone of anterior testis. Cirrus sac elongated-pyriform, 0.13 to 0.15 mm. long by 0.04 to 0.05 mm. wide, containing convoluted seminal vesicle, ejaculatory duct, and eversible cirrus, extending posteriorly far enough for one-third to two-thirds of its length to lie dorsally to acetabulum. Ovary entire, round to transversely oval, 0.04 to 0.08 mm. long by 0.08 to 0.11 mm. wide, on midline or slightly to one or other side of that line, separated from posterior testis by one or two loops of uterus. Seminal receptacle globular, entirely posterior to ovary, against dorsal body wall. Mehlis' gland and yolk reservoir median to seminal receptacle. Laurer's canal not observed. Vitellaria (fig. 37, *c-f*) consisting of 6 to 14 large irregular masses of yolk cells, individual masses joined together by distinct ducts and glands usually joined across body at their anterior limits to form a wide connecting bridge just beneath dorsal body wall. Uterus greatly convoluted, with rather indistinct loops, filling most of body posterior to vitellaria, passing anteriorly between and ventrally to vitellaria, ventrally to middle or either margin of ovary, to dorsal side of body between posterior testis and ovary, either right or left side of posterior testis between testes, dorsally to acetabulum where it forms several loops before reaching genital pore. Mature ova few in number, dark brown in color,  $39\mu$  to  $44\mu$  long by  $22\mu$  to  $28\mu$  wide.

*Host*.—*Seiurus aurocapillus* (Linnaeus).

*Habitat*.—Liver.

*Locality*.—VIRGINIA: Mountain Lake.

*Type specimen*.—U.S.N.M. Helm. Coll. No. 37118.

*Remarks*.—*Brachylecithum seiuricum* is described from 18 specimens from the liver of one of 14 ovenbirds, *Seiurus aurocapillus*. In its combination of characters of having a slender body with suckers approximately equal in size, testes not exceeding acetabulum in size, ovary slightly smaller than testes, ceca not extending posterior to vitellaria, genital pore anterior to intestinal bifurcation and the fused vitellaria, *B. seiuricum* is unique among the already described species of the genus. From *B. americanum* and *B. moorei*, which it superficially resembles, *B. seiuricum* is readily distinguished by its more



anterior genital pore, shorter ceca, its more posteriorly located seminal receptacle, its fused vitellaria, and its completely separated testicular zones.

**BRACHYLECITHUM DELICATUM, new species**

FIGURE 37, *g-l*

*Diagnosis.*—Body thin, semitransparent, elongated, with almost parallel sides and rounded anterior and tapering posterior ends; it measures 1.43 to 2.18 mm. long by 0.17 to 0.20 mm. wide in region between posterior testis and vitellaria. Cuticle thin, aspinose, with fine transverse ridges, and with small sensory papillae on margins of body in some specimens. Oral sucker subterminal to small liplike anterior end of body, weakly muscular, elongated oval, 0.10 to 0.13 mm. long by 0.08 to 0.10 mm. wide. Acetabulum weakly muscular, protrusible, 0.10 to 0.14 mm. in diameter, with center protruded (fig. 37, *h*), in anterior fourth of body. Ratio of width of oral sucker to acetabulum 1:1.07 to 1.41. Prepharynx absent. Pharynx muscular, globular, 0.03 to 0.04 mm. long by 0.03 mm. wide. Esophagus very thin walled, slender, slightly wavy, bifurcating from one-half to three-fifths of distance from oral sucker to acetabulum. Ceca thin walled, of medium width, slightly wavy, with extreme terminal portions slightly dilated, terminating unevenly in zone of vitellaria or just posterior to that zone. Excretory pore terminal. Excretory vesicle thin-walled, tubular, narrow, extending anteriorly to about middle of vitellaria. Genital pore median, ventral to intestinal bifurcation or slightly anterior to it. Testes round to oval, approximately equal in size, 0.08 to 0.17 mm. long by 0.07 to 0.14 mm. wide, with smooth to slightly lobed margins (fig. 37, *i*) in oldest specimen, slightly oblique in position. Anterior testis located immediately posterior to acetabulum or separated from it by a single uterine loop; posterior testis entirely behind anterior one. Vasa efferentia uniting just in front of anterior testis to form a short vas deferens. Cirrus sac elongated-pyriform, 0.09 to 0.12 mm. long by 0.03 to 0.05 mm. wide, containing convoluted seminal vesicle, ejaculatory duct and eversible cirrus, with its posterior end at or slightly below cephalic margin of acetabulum. Ovary round to oval in shape, 0.05 to 0.12 mm. in diameter, with smooth to slightly irregular margins, on midline or slightly to one or other side of body, separated from posterior testis by one loop of ascending uterus. Seminal receptacle globular, posterior to ovary, midway between ovary and vitellaria. Mehlis' gland and yolk reservoir posteromedial to seminal receptacle. Laurer's canal not observed. Vitellaria (fig. 37, *g, j-l*) consisting of 7 to 10 medium-sized irregular or transversely elongated follicles on each side of body. Vitelline ducts arise from anterior follicles on each side and pass



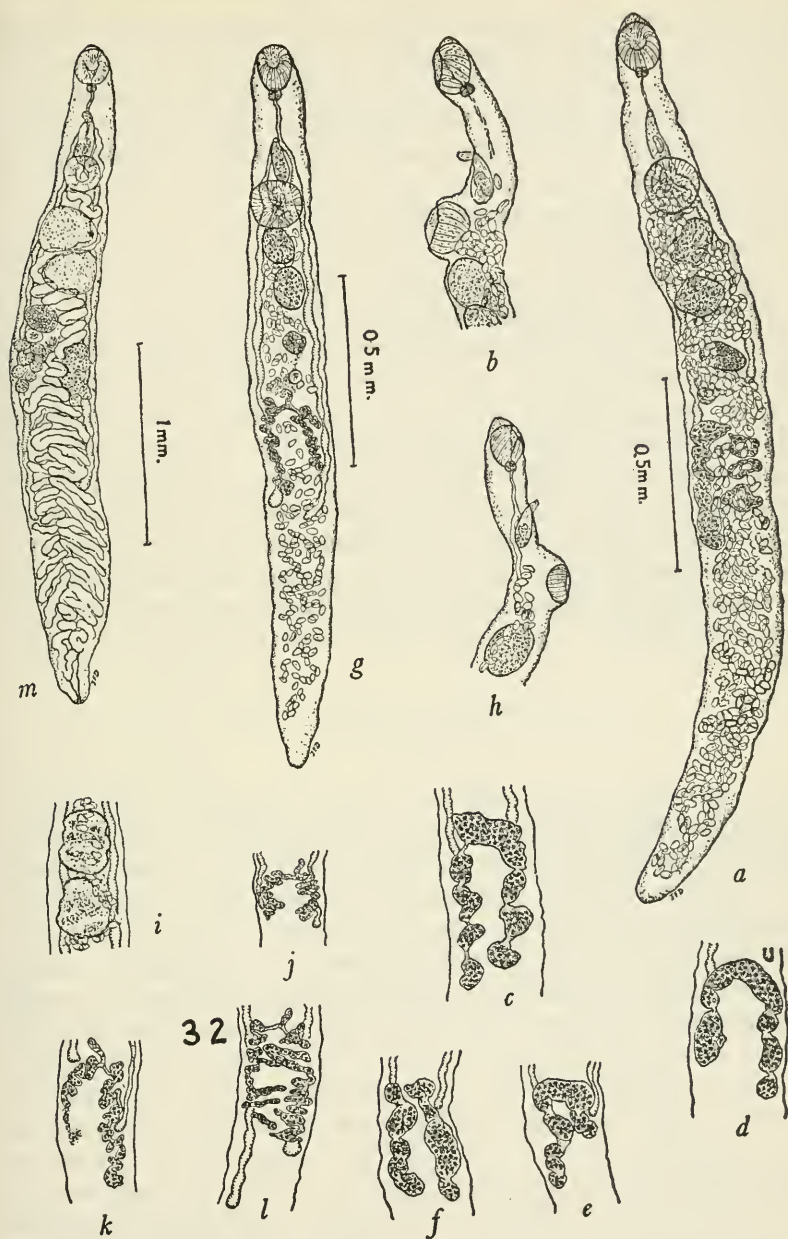


FIGURE 37.—*a*, *Brachylecithum seiuricum*, new species, from the liver of *Seiurus aurocapillus*, ventral view; *b*, lateral view of anterior end of *Brachylecithum seiuricum*, from *Seiurus aurocapillus*, showing center of acetabulum protruded; *c*, *d*, *e*, *f*, sketches showing the variation in the vitellaria and ends of the ceca in different specimens of *Brachylecithum seiuricum*, from *Seiurus aurocapillus*; *g*, *Brachylecithum delicatum*, new species, from the liver of *Pipilo erythrophthalmus*, ventral view; *h*, lateral view of anterior end of *Brachylecithum delicatum*, from *Pipilo erythrophthalmus*; *i*, sketch, showing the lobation of the testes in an older specimen of *Brachylecithum delicatum* from *Pipilo erythrophthalmus*; *j*, *k*, *l*, sketches showing the variation in the vitellaria and in the length of the ceca in *Brachylecithum delicatum*, from *Pipilo erythrophthalmus*; *m*, *Brachylecithum moorei*, new species, from the liver of *Bubo virginianus*, ventral view.

mesially to join, forming yolk reservoir. Uterus convoluted, filling most of body posterior to vitellaria then passing between and ventrally to vitellaria, to either right or left of ovary, usually between ovary and posterior testis, between testes and dorsal to acetabulum to genital pore. Mature ova few in number, dark brown in color,  $34\mu$  to  $40\mu$  long by  $19\mu$  to  $26\mu$  wide.

*Host*.—*Pipilo erythrophthalmus* (Linnaeus).

*Habitat*.—Liver.

*Locality*.—NORTH CAROLINA: Highlands.

*Type specimen*.—U.S.N.M. Helm. Coll. No. 37119.

*Remarks*.—*Brachylecithum delicatum* is described from 12 young, although sexually mature, specimens found in association with other species of *Brachylecithum* in the liver of a red-eyed towhee, *Pipilo erythrophthalmus*, from Highlands, N. C. The species is very similar to *B. seiuricum* but differs from that in having a somewhat shorter esophagus, in having the genital pore more posterior, ventrally to the intestinal bifurcation, in the nature and arrangement of the vitellaria, and in the smaller ova. The slightly larger pharynx, somewhat longer ceca, smaller cirrus sac, and the different configuration of the uterus in *B. delicatum* are minor differences that may have specific values.

BRACHYLECITHUM MOOREI, new species

FIGURE 37, m

*Diagnosis*.—Body elongated, dorsoventrally flattened, 3.38 to 4.31 mm. long by 0.27 to 0.52 mm. wide in region of vitellaria, with weakly developed musculature, almost parallel sides which taper slightly toward both extremities. Cuticle thin, without spines or other obvious markings. Oral sucker weakly muscular, elongated-oval, 0.18 to 0.26 mm. long by 0.17 to 0.23 mm. wide, subterminal to a short liplike projection. Acetabulum 0.17 to 0.28 mm. in diameter, weakly muscular, somewhat protrusible, with center protruded far enough to obliterate lumen, in anterior fourth of body. Ratio of width of oral sucker to acetabulum 1:1.12 to 1.21. Pharynx globular, muscular, 0.05 to 0.07 mm. in diameter. Esophagus narrow, very thin-walled, straight to slightly wavy, 0.14 to 0.23 mm. long, bifurcating midway between suckers. Ceca narrow, slightly undulating, passing laterally to genital organs and dorsally to vitellaria, terminating from one-third to one-half of distance from vitellaria to posterior end of body. Excretory pore terminal. Genital pore median, ventral to intestinal bifurcation. Testes large, oval, approximately equal in size, 0.20 to 0.35 mm. in diameter, tandem in position, with zones contiguous but not overlapping in relaxed specimens. Zone of anterior testis separated from zone of acetabulum by one to three loops of uterus. Cir-

rus sac elongated-oval, 0.20 to 0.31 mm. long by 0.09 to 0.14 mm. wide, containing convoluted seminal vesicle, ejaculatory duct and eversible cirrus. Cirrus sac situated so that caudal extremity reaches to or slightly beyond anterior margin of acetabulum. Ovary round to transversely oval in shape, smaller than testes, 0.13 to 0.19 mm. in transverse diameter, on either right or left side of body, separated from posterior testis by one to three loops of uterus. Seminal receptacle small, globular, contiguous to caudal margin of ovary. Mehlis' gland diffuse, medially to seminal receptacle. Laurer's canal not observed. Vitellaria consisting of 6 to 14 large follicles on each side of body, with more follicles on side of body opposite ovary, located just posterior to seminal receptacle. Uterus greatly convoluted, filling most of body posterior to ovary, ascending to genital pore by one of three courses: (1) Passing to either right or left of ovary, between ovary and posterior testis, between testes, then anteriorly by a wavy course; (2) passing to either right or left of both ovary and posterior testis, between testes, then anteriorly by wavy course; or (3) passing to either right or left of all three gonads, then anteriorly by wavy course. Mature ova dark brown,  $36\mu$  to  $44\mu$  long by  $23\mu$  to  $29\mu$  wide.

*Host*.—*Bubo virginianus* (Gmelin).

*Habitat*.—Liver.

*Locality*.—United States (probably Texas).

*Type specimen*.—U.S.N.M. Helm. Coll. No. 37120. Additional specimen No. 37121.

*Remarks*.—*Brachylecithum moorei* is described from about 50 specimens taken from the liver of a great horned owl, *Bubo virginianus*. The host died while in the Zoological Gardens, Houston, Tex. Although the bird probably came from the vicinity of Houston, the exact locality from which it was taken could not be determined. It appears to be more closely related to *B. americanum* Denton, 1945, than to the other members of the genus. From this species it is distinguished by the longer ceca, oval instead of lobed testes, and a larger cirrus sac.

#### BRACHYLECITHUM AMERICANUM Denton, 1945

##### FIGURE 38, a

*Brachylecithum americanum* DENTON, Journ. Parasitol., vol. 31, pp. 131-140, figs. 1-8, 1 pl., 1945.

As recently as September 1948, 18 specimens of a form identifiable as *Brachylecithum americanum* Denton, 1945, were removed from the liver of an immature red-shouldered hawk, *Buteo lineatus* (Gmelin), from Athens, Ga. This material agrees remarkably well with that from crows, *Corvus brachyrhynchos* Brehm, from the same locality in



(1) size, shape, and relative position of suckers; (2) ratio of sucker sizes (1:1.0 to 1.1); (3) position of genital pore; (4) size, shape, and relative position of the genital organs; (5) number and size of vitelline follicles; and (6) the course of the uterus in ascending to genital pore. In general, specimens from the crow are slightly wider and thicker in proportion to length than specimens from birds of the family Icteridae (blackbirds). The material from the hawk is still wider and thicker in proportion to the length than are those from the crow. There seems, then, to be some evidence to indicate that there is a definite correlation between the size of the host (and its bile ducts) and the size of the specimens of this species that parasitize it.

The specimens from the hawk measure 2.28 to 2.90 mm. long by 0.38 to 0.52 mm. wide. The cuticle of some specimens shows fine transverse striations. The weakly muscular acetabulum shows a shallow, saucerlike lumen in some specimens, while in others the center is protruded so as to obliterate the lumen. The vasa efferentia arise from the dorsomedial surfaces of the testes and unite just in front of the anterior testis, at the caudal margin of acetabulum, to form a short vas deferens. A specimen has been deposited in the United States National Museum, Helm. Coll. No. 37123.

Since *B. americanum* has not been reported previously from any species of hawk, it is considered to be a rare parasite of this avian group. Denton and Rausch (1949) failed to find a single specimen of the species in 160 hawks, 8 of which were of the red-shouldered variety.

**BRACHYLECITHUM STUNKARDI (Pande, 1939), new combination**

**FIGURE 38, b**

*Lyperosomum stunkardi* PANDE, Proc. Nat. Acad. Sci. India, vol. 9, pp. 16-19, figs. 1-2, 1939.

*Olssoniella stunkardi* TRAVASSOS, Monogr. Inst. Oswaldo Cruz, No. 2, p. 221, est. 83, fig. 4; est. 85, fig. 3, 1944.

*Description*—Body muscular, cylindrical to slightly flattened, with rounded anterior and tapering posterior ends, measuring 2.82 to 3.98 mm. long by 0.22 to 0.30 mm. wide in region of vitellaria. Cuticle thick, aspinose, finely wrinkled transversely. Oral sucker 0.16 to 0.23 mm. in diameter, muscular, subterminal to a short lip-like projection. Acetabulum 0.19 to 0.28 mm. long by 0.22 to 0.35 mm. wide, located one-sixth to one-seventh of body length from anterior end; fairly muscular, somewhat protrusible, with center often protruded so as to obliterate its lumen; with a small, flat appendage on each lateral margin. Ratio of width of oral sucker to acetabulum 1:1.35 to 1:1.75. Pharynx muscular, 0.05 to 0.07 mm. in diameter. Esophagus in relaxed specimens narrow, 0.20 to 0.32 mm. long,



straight to slightly wavy, bifurcating dorsal to cephalic margin of acetabulum. Ceca slender, becoming bulbous toward posterior ends in some specimens, slightly sinuous, terminating at different levels,

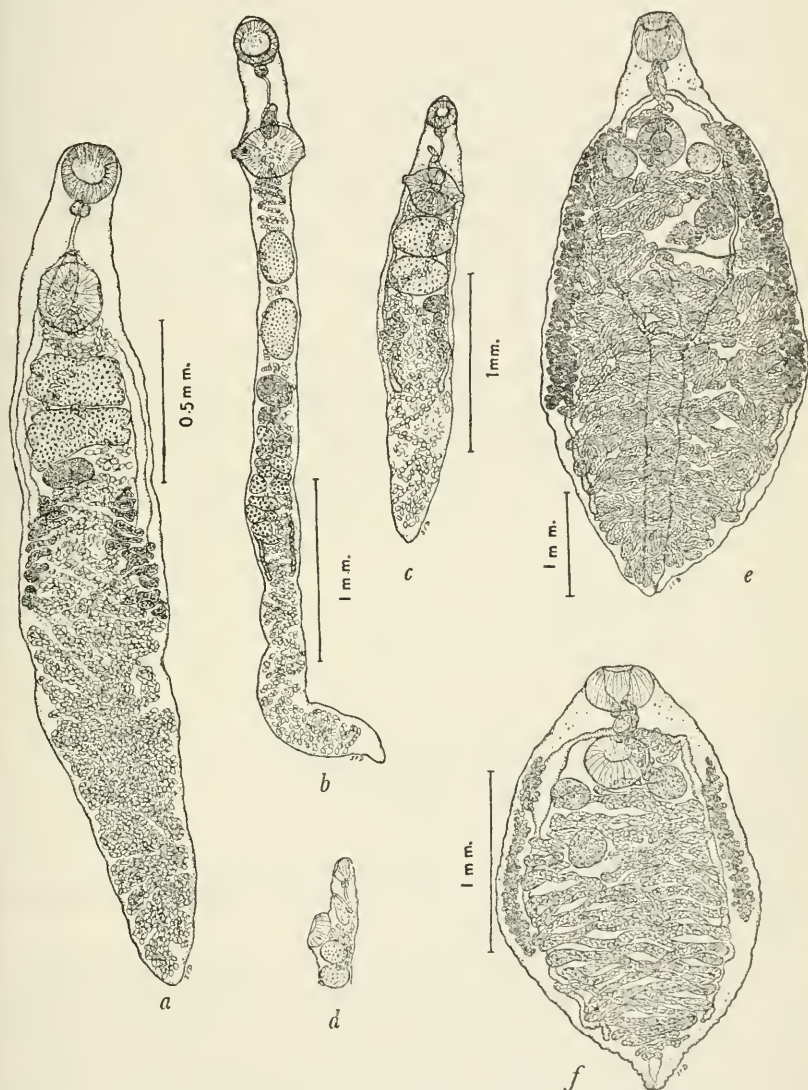


FIGURE 38.—*a*, *Brachylecithum americanum* Denton, 1945, from the liver of *Buteo lineatus*, ventral view (the testes are tandem in position rather than oblique as they usually are); *b*, *Brachylecithum stunkardi* (Pande, 1939), from the liver of *Cyanocitta cristata*, ventral view; *c*, *Brachylecithum exochocotyle*, new species, from the liver of *Toxostoma rufum*, ventral view; *d*, lateral view of anterior end of *Brachylecithum exochocotyle*, from *Toxostoma rufum*, showing position of suckers and shallow lumen of acetabulum; *e*, *Lubens lubens* (Braun, 1901), from the gall bladder of *Cassidix mexicanus prosopidicola*, ventral view; *f*, *Lubens lubens*, from the gall bladder of *Piranga olivacea*, ventral view.

from one-fourth to one-half the distance from vitellaria to posterior end of body. Excretory pore terminal. Excretory vesicle tubular, voluminous, and somewhat sinuous, extending anteriorly to level of posterior vitelline follicles. Genital pore median, about two-thirds of distance from oral sucker to acetabulum, and well in front of intestinal bifurcation. Testes large, 0.10 to 0.36 mm. in greatest diameter, round to oval, the long axis varying with state of contraction, located one directly behind the other and occupying almost entire width of body. Anterior testis separated from acetabulum by 6 to 9 loops of uterus in relaxed specimens; posterior testis separated from anterior testis by a single uterine loop. Cirrus sac large, bulb-shaped, 0.14 to 0.19 mm. long by 0.07 to 0.09 mm. wide, containing a convoluted seminal vesicle, ejaculatory duct and muscular eversible cirrus, situated so that the posterior one-half to three-fourths of its length lies dorsally to acetabulum. Ovary transversely oval, 0.07 to 0.19 mm. long by 0.15 to 0.25 mm. wide, situated immediately behind posterior testis and separated from it by a single uterine loop. Seminal receptacle globular, 0.05 to 0.08 mm. in diameter, immediately posterior to ovary. Mehlis' gland large, situated posterolaterally to seminal receptacle. Laurer's canal not observed. Each vitellaria composed of 8 to 12 large ovoid follicles, located immediately posterior to Mehlis' gland and beginning at about equator of body. Uterus convoluted, filling greater part of body posterior to vitellaria, then passing ventral or to either side of ovary, dorsal or to either side of posterior testis, between testes or dorsal to anterior testis, to form 6 to 9 lateral loops before passing to genital pore. Mature ova light to dark brown,  $30\mu$  to  $41\mu$  long by  $21\mu$  to  $27\mu$  wide ( $38\mu$  to  $45\mu$  by  $28\mu$  to  $33\mu$  before preservation).

*Host*.—*Cyanocitta cristata* (Linnaeus).

*Habitat*.—Liver.

*Localities*.—TEXAS: Houston; VIRGINIA: Mountain Lake.

*Material*.—A specimen has been deposited in United State National Museum, Helm. Coll. No. 36795.

*Remarks*.—*Brachylecithum stunkardi* is described here from 16 young specimens obtained from the liver of a blue jay, *Cyanocitta cristata*, collected at Houston, Tex., and 9 specimens just reaching sexual maturity from the same host obtained at Mountain Lake, Va. Since this trematode was found in only two (7.7 percent) of 26 blue jays examined from various localities, it apparently is not very common in this host.

The material in the present collection, although slightly smaller and possibly younger, agrees very closely with that described by Pande (1939) in (1) shape of the body; (2) size, shape, and relative position of the suckers; (3) size, shape, and relative position of geni-

tal organs; (4) position of the genital pore; (5) position and shape of vitellaria; (6) course of the uterus; and (7) size of ova. Our material differs from Pande's in having the intestinal bifurcation more posterior in position; it lies dorsal to the cephalic portion of the acetabulum, with the result that the genital pore is anterior to the intestinal bifurcation in our specimens, while it is posterior to the bifurcation in the material described by Pande.

*Brachylecithum eophonae* described by Yamaguti (1941) from a finch, *Eophona personata*, seems to differ from *B. stunkardi* only in having slightly larger ova. We consider the two forms to be synonymous. Furthermore, we are of the opinion that the material from *Corvus corone* described briefly and figured by Braun (1902, plate 6, figure 66) as *Lyperosomum* sp. is unquestionably a representative of *B. stunkardi*.

*Brachylecithum stunkardi* is closely related to *B. lobatum* (Raillet, 1900) and may possibly be a synonym of it. As pointed out by Travassos (1944, pp. 210-212) considerable confusion concerning the characteristics of *B. lobatum* exists, resulting from authors' confusing it with *L. longicauda* (Rudolphi, 1809), and possibly with other similar forms that occur in the same host group. Until adequate descriptions of *B. lobatum* and *L. longicauda* are available for comparison and the confusion concerning these forms is cleared up, we feel justified in retaining *B. stunkardi* as a separate species.

#### BRACHYLECITHUM EXOCHOCOTYLE, new species

##### FIGURE 38, c, d

*Diagnosis*.—Body elongated, slightly flattened, 1.42 to 2.50 mm. long by 0.28 to 0.59 mm. wide, widest in region of vitellaria. Cuticle aspinose, finely striated transversely, with small retractile sensory papillae on margins of anterior third of body. Oral sucker subterminal to a short liplike projection, 0.16 to 0.18 mm. long by 0.15 to 0.17 mm. wide. Acetabulum large, 0.22 to 0.28 mm. long by 0.28 to 0.35 mm. wide, with a small, flat, conical thickening on each lateral margin, located about one-sixth of body length from anterior end. Ratio of width of oral sucker to acetabulum 1:1.8 to 1:2.1. Pharynx 0.05 to 0.07 mm. long by 0.06 to 0.09 mm. wide. Esophagus narrow, slightly wavy, 0.09 to 0.13 mm. long, bifurcating about two-thirds the distance from oral sucker to acetabulum. Ceca slender, slightly sinuous, terminating a short distance posterior to vitellaria. Excretory pore terminal. Genital pore median, ventral to intestinal bifurcation. Testes conspicuously large, transversely oval, 0.14 to 0.25 mm. long by 0.22 to 0.46 mm. wide, located one immediately behind the other, with anterior one contiguous to or slightly overlapping zone of acetabulum. Cirrus sac large, oval, 0.13 to 0.19 mm. long by 0.08 to 0.13 mm. wide, contain-



ing coiled seminal vesicle and eversible cirrus, with approximately posterior half lying dorsally to anterior margin of acetabulum. Ovary oval in shape, small, 0.07 to 0.12 mm. long by 0.11 to 0.17 mm. wide, located immediately behind posterior testis, lateral in position, with outer margin pressed close against either right or left cecum. Seminal receptacle large, globular, located posteromedially to ovary. Vitellaria composed of 8 to 12 large oval follicles on each side of body, located immediately posterior to ovary. Uterus convoluted filling greater part of body posterior to ovary, then passing to either right or left of posterior testis and ovary, dorsal to anterior testis, to describe two or three lateral loops dorsal to acetabulum before ascending to genital pore. Mature ova dark brown,  $46\mu$  to  $53\mu$  long by  $27\mu$  to  $32\mu$  wide.

*Host*.—*Toxostoma rufum* (Linnaeus).

*Habitat*.—Liver.

*Locality*.—GEORGIA: Athens.

*Type specimen*.—U.S.N.M. Helm. Coll. No. 37122. Additional specimens, Nos. 36755 and 36756.

*Remarks*.—*Brachylecithum exochocotyle* is described from more than 75 specimens removed from the liver of a brown thrasher, *Toxostoma rufum*, obtained at Athens, Ga. This infection, the only one (2.44 percent) encountered in 41 brown thrashers examined from various localities, occurred as a double infection with *Lyperosomum oswaldoi*. The bird, which was found in a dying condition with its liver almost completely destroyed, was the only host examined that showed definite evidence of being harmed by its dicrocoeliid infections.

*Brachylecithum exochocotyle* can be separated from *B. stunkardi*, which it resembles very closely, by its shorter and wider body, its relatively smaller oral sucker, its large oval testes, its relatively smaller ovary, and especially in the difference in size and appearance of the vitelline follicles.

#### Genus ATHESMIA Looss, 1899

##### ATHESMIA HETEROLECITHODES (Braun, 1899)

##### FIGURE 36, f

*Distomum heterolecithodes* BRAUN, Zool. Anz., vol. 22, p. 3, 1899.

*Athesmia reelfooti* DENTON, in Petri, Trans. Amer. Micr. Soc., vol. 61, p. 60, 1942.

A single mature specimen belonging to the genus *Athesmia* was dissected from the liver of a Florida gallinule, *Gallinula chloropus cachinnans* Bangs, collected at Reelfoot Lake, Tenn. It is possible to assign this material to *A. heterolecithodes* (Braun, 1899), although our specimen differs somewhat from this species as redescribed by Jacoby (1899a, b) in having a narrower and longer body, relatively shorter ceca, more posterior genital pore, and a smaller cirrus pouch.



The differences noted, except possibly the difference in the size of the cirrus pouch, can be attributed to a difference in the state of body contractions. Since this is the first time *A. heterolecithodes* has been reported from the New World, a detailed description of the specimen is given below.

*Description.*—Body slender and semitransparent, approximately 11.4 mm. long by 0.69 mm. wide at level of acetabulum; sides almost parallel. Cuticle thin, without spines. Oral suckers subterminal, 0.44 mm. long by 0.43 mm. wide. Acetabulum smaller, 0.36 mm. in diameter, situated about one-seventh of body length from anterior end. Pharynx 0.10 mm. in diameter. Esophagus narrow and straight, 0.39 mm. long, bifurcating about two-fifths the distance from oral sucker to acetabulum. Ceca slender, unequal in length, extending to about level of caudal extremity of vitellarium. Excretory pore terminal. Genital pore median, a short distance posterior to intestinal bifurcation. Anterior testis 0.51 mm. long by 0.26 mm. wide, irregular in outline, deeply fissured on lateral margins, situated toward same side of body as vitellarium. Posterior testis 0.52 mm. long by 0.26 mm. wide, of same shape as anterior testis, situated on opposite side of body, 0.87 mm. behind level of anterior testis. Cirrus sac pear-shaped, 0.24 mm. long by 0.14 mm. wide, containing coiled seminal vesicle and eversible cirrus. Ovary small, 0.16 mm. long by 0.27 mm. wide, deeply lobed, situated preequatorily on opposite side of body from vitellarium. Seminal receptacle large, globular, just posterior to ovary. Mehlis' gland at posteromedial margin of seminal receptacle. Vitellarium unilateral, consisting of numerous small follicles, divided into one large and two small groups, extending from level of Mehlis' gland through a distance of 3.43 mm. on right side of body. Uterus with many coils, descending first to posterior end of body, then ascending, passing to right of ovary and posterior testis, to left of anterior testis and dorsal to acetabulum and cirrus sac to genital pore. Mature ova dark brown,  $33\mu$  to  $38\mu$  long by  $23\mu$  to  $25\mu$  wide.

*Additional host.*—*Gallinula chloropus cachinnans* Bangs.

*Habitat.*—Liver.

*Locality.*—TENNESSEE: Reelfoot Lake.

*Material.*—The specimen has been deposited in the United States National Museum, Helm. Coll. No. 36732.

Genus LUBENS Travassos, 1920

LUBENS LUBENS (Braun, 1901)

FIGURE 38, e, f

*Dicrocoelium lubens* BRAUN, Centralbl. Bakt. Parasit., vol. 29, p. 945, 1901.

*Euritrema (Lubens) lubens* TRAVASSOS, Arch. Esc. Sup. Agr. e Med. Vet. Nictheroy, vol. 3 (1919), pp. 19–20, 1920.

*Lubens lubens* (Braun, 1901) STROM, Parasitol. Sborn. Zool. Inst. Acad. Nauk U. S. S. R., vol. 8, p. 180, 1940.

*Description.*—Body thick and broadly oval, tapering toward extremities, measuring 5.36 to 5.64 mm. long by 2.25 to 2.64 mm. wide, widest near posterior end of vitellaria. Cuticle thick, without spines, transversely wrinkled, and with retractile sensory papillae on the preacetabular margins of body. Oral sucker muscular, subterminal in position, oval in shape and measuring 0.42 to 0.47 mm. in diameter. Acetabulum muscular, 0.42 to 0.50 mm. in diameter, situated relatively close to oral sucker within anterior fourth of body. Ratio of sucker diameters about 1:1. Pharynx large, globular, 0.16 mm. long by 0.19 to 0.21 mm. wide. Esophagus short, straight, approximately equal in length to pharynx. Intestine bifurcating at approximately two-thirds the distance from oral sucker to acetabulum. Ceca narrow, slightly sinuous, passing dorsal to lateral margins of testes and medial margins of vitellaria to terminate about midway between ends of vitellaria and posterior end of body. Excretory pore terminal. Excretory vesicle tubular and voluminous, extending anteriorly to about equator of body where it receives a common collecting tubule from each side of body. Each common collecting tubule passing anterolateral to posterior level of testes where it divides into an anterior and posterior main collecting tubule. Genital pore median, at posterior level of pharynx. Testes rounded, approximately equal in size, 0.30 to 0.50 mm. in diameter, situated directly opposite each other, lateral to the acetabulum with their zones lying almost entirely within that of acetabulum. Cirrus sac small, club-shaped, 0.38 mm. long by 0.11 mm. wide (single specimen), extending slightly posterior to intestinal bifurcation, containing convoluted seminal vesicle, prostatic gland cells, and eversible cirrus. Ovary rounded, 0.28 to 0.43 mm. in diameter situated either to right or left side of body close behind the respective testis. Seminal receptacle small, situated dorsal to posteromedial margin of ovary. Mehlis' gland diffuse, located ventral to medial margin of seminal receptacle. Vitellaria composed of numerous oval follicles, situated in lateral margins of body, extending posteriorly from within zone of acetabulum for a distance of 2.67 to 2.96 mm. (or about half the total body length). Vitelline ducts arising at point approximately midway the vitellaria. Uterus very voluminous and greatly convoluted, filling most of postacetabular region of body and sending characteristic loops lateral to testes to anterior level of acetabulum before following a wavy course to genital pore. Mature ova numerous, dark brown,  $26\mu$  to  $31\mu$  long by  $17\mu$  to  $23\mu$  wide, fully embryonated when oviposited. Miracidium symmetrical, ciliated, possessing a stylet and having two large oval oppositely situated

vesicles in the posterior half of body; vesicles containing highly refractile granules.

*Additional hosts.*—*Cassidia mexicanus prosopidicola* Lowery and *Piranga olivacea* (Gmelin).

*Habitat.*—Gall bladder.

*Localities.*—TEXAS, Eagle Lake; VIRGINIA, Mountain Lake.

*Material.*—A specimen from the mesquite grackle has been deposited in the United States National Museum, Helm. Coll. No. 36746.

*Remarks.*—The above description of *Lubens lubens* is based on four mature specimens from the gall bladders of two of nine mesquite grackles, *Cassidia mexicanus prosopidicola*, collected at Eagle Lake, Tex. The infected birds contained one and three worms, respectively, and each was infected with another species of dicrocoeliid trematode. These specimens fit perfectly into the present concept of *L. lubens*, which was recently expanded by Travassos (1944) to include four former species and specimens from 27 different hosts. This species has not heretofore been reported from North America or any place outside of Brazil.

In addition to the worms from the mesquite grackles, a single mature specimen of this species was found in the gall bladder of a scarlet tanager, *Piranga olivacea*, collected at Mountain Lake, Va. This specimen (fig. 38, f), although it is sexually mature and has the uterus distended with eggs, measures only 2.45 mm. long by 1.51 mm. wide. The oral sucker measures 0.27 mm. long by 0.39 mm. wide. The acetabulum 0.29 mm. long by 0.39 mm. wide. Ratio of oral sucker to acetabulum 1:1. The testes measure 0.21 mm. and 0.24 mm. in greatest diameter. The ovary is 0.18 mm. long by 0.27 mm. wide. The vitellaria extend 0.95 mm. along the sides of the body. The cirrus pouch measures 0.16 mm. long by 0.08 mm. wide. The ova are  $40\mu$  to  $43\mu$  long by  $23\mu$  to  $24\mu$  wide.

#### Genus CONSPICUUM Bhalerao, 1936

##### CONSPICUUM ICTERIDORUM, new species

##### FIGURE 39, a, b

*Diagnosis.*—Body fairly thick and muscular, elongated oval, tapering to posterior end, 2.20 to 5.97 mm. long by 0.70 to 1.97 mm. wide, widest in region between testes and ovary. Cuticle thick, without spines, smooth or with fine transverse wrinkles when slightly contracted. An undetermined number of small retractile sensory papillae visible on lateral margins of anterior half of body; papillae much more numerous on the inconspicuous dorsal liplike projection and along lateral margins of oral sucker. Oral sucker strongly muscular, subterminal, 0.20 to 0.58 mm. in diameter. Acetabulum large and muscular, with deep cup-shaped lumen, situated at junction of ante-



rior and middle body thirds; it measures 0.38 to 0.82 mm. in diameter. Ratio of diameter of oral sucker to acetabulum varying from 1:1.3 to 1:1.9. Prepharynx absent. Pharynx globular, 0.08 to 0.23 mm. in diameter. Esophagus narrow, usually slightly wavy, 0.08 to 0.40 mm. long, bifurcating one-half to two-thirds the distance from oral sucker to acetabulum. Ceca of medium width, straight to slightly wavy, passing outside of lateral margins of testes to terminate about midway between ends of vitellaria and posterior end of body. Cerebral ganglion conspicuous, ventral to posterior margin of pharynx. Excretory pore terminal. Excretory vesicle (fig. 39, *b*) simple, tubular, extending anteriorly through about one-third of body length, receiving a common collecting tubule from each side. Each common collecting tubule rather voluminous, passing anterolaterally between testes and acetabulum to divide into an anterior and posterior main collecting tubule at level of equator of acetabulum. Each anterior and posterior main collecting tubule on each side of body giving rise to three short accessory tubules. Each accessory tubule branching into a dorsal and ventral capillary tubule, each of which terminates in a single flame cell. Flame cell pattern 2 [(2+2+2) + (2+2+2)]. Genital pore median, at level of pharynx. Testes rounded, 0.09 to 0.45 mm. in diameter, situated directly opposite with their fields widely separated and their zones immediately behind or overlapping that of acetabulum. Vasa efferentia arising from anteromedial margin of testes and passing anteriorly and medially to unite as they enter cirrus sac. Cirrus sac elongated, 0.24 to 0.73 mm. long by 0.09 to 0.34 mm. wide, containing a convoluted seminal vesicle, ejaculatory duct surrounded by prostatic gland cells and eversible cirrus; it usually lies entirely in front of acetabulum. Ovary round to transversely oval, 0.10 to 0.36 mm. in greatest diameter, situated submedially, relatively far from testes. Seminal receptacle globular, located dorsal or posterior to caudal margin of ovary. Mehlis' gland situated medially to seminal receptacle. Laurer's canal present. Vitellaria composed of numerous medium-sized oval follicles, mainly extracecal, extending posteriorly from within testicular zones for a distance of 0.82 to 2.11 mm. (about two-thirds distance to posterior end of body). Vitelline ducts arising from about middle of vitellaria. Uterus convoluted, filling most of posttesticular region of body, then following an undulating course to genital pore. Mature ova dark brown,  $27\mu$  to  $33\mu$  long by  $17\mu$  to  $23\mu$  wide, fully embryonated with oviposited. Miracidium symmetrical, ciliated, possessing a stylet and with two large oppositely situated vesicles in the posterior half of body; vesicles containing highly refractile granules.

*Hosts*.—*Quiscalus quiscula aeneus* Ridgway (type), *Quiscalus quiscula quiscula* (Linnaeus), *Cassidia mexicanus prosopidicola*



Lowery, *Cassidix mexicanus major* (Vieillot), *Euphagus Carolinus* (Müller), and *Sturnella magna argutula* Bangs.

*Habitat*.—Gall bladder.

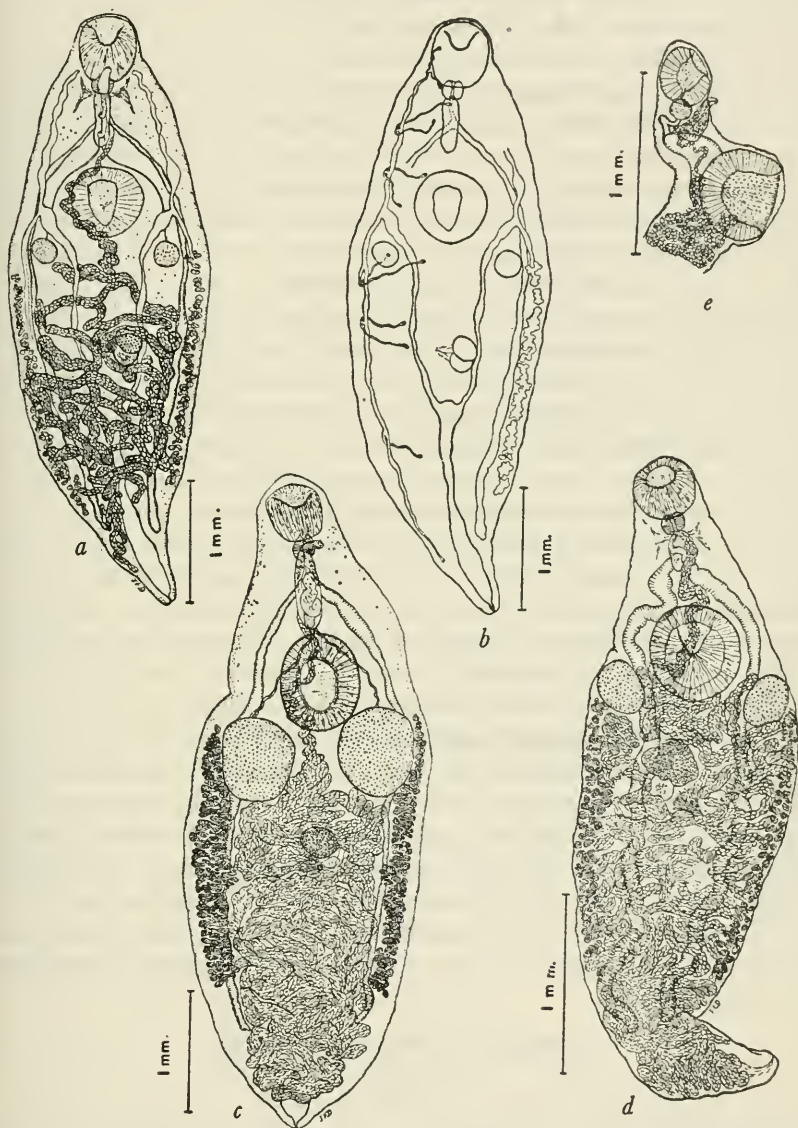


FIGURE 39.—a, *Conspicuum icteridorum*, new species, from the gall bladder of *Quiscalus quiscula aeneus*, ventral view; b, excretory system of *Conspicuum icteridorum* (freehand sketch on camera lucida outline); c, *Conspicuum macrorchis*, new species, from gall bladder of *Corvus brachyrhynchos*, ventral view; d, *Zonorchis alveyi* (Martin and Gee, 1949), from the gall bladder of *Pipilo erythrophthalmus*, ventral view; e, optical sagittal section of anterior end of *Zonorchis alveyi*, from *Pipilo erythrophthalmus*, showing relative position of organs and deep lumen of acetabulum.

*Localities.*—TEXAS: Eagle Lake (type), and Houston; TENNESSEE: Nashville, Stone River Park, Mount Juliet, and Reelfoot Lake; GEORGIA: Augusta and Athens; MICHIGAN: East Lansing.

*Molluscan host.*—*Deroceras laeve* (Müller).

*Type specimen.*—U.S.N.M. Helm. Coll. No. 36740. Additional specimens, Nos. 36741, 36742, 36743, and 36744.

*Remarks.*—*Conspicuum icteridorum* is described from some 70 specimens obtained from the gall bladders of the six hosts collected in the various localities listed above. Of 50 individuals of the avian host species examined by us, 42 percent were infected with this trematode. Individual birds harbored 1 to 18 worms, 5 being the average per bird. The bronzed grackle, *Quiscalus quiscula aeneus*, has been found infected more often than the other host species.

*Conspicuum icteridorum* is more closely related to *C. conspicuum* (Faria, 1912) as redescribed by Travassos (1944) than to other members of the genus. The present material cannot be assigned to that species because of one striking and several minor differences. Travassos emphasizes that in *C. conspicuum* the vasa efferentia fuse to form a long vas deferens about midway between the testes and cirrus pouch and states that this curious arrangement has been observed in only one other Brazilian dicrocoeliid, *Concinnum ellipticum* (Travassos, 1941). In our material from all six hosts the vasa efferentia remain separated up to the point of entrance into the cirrus pouch. Although little or no significance is attached to egg size as a distinguishing characteristic of dicrocoeliids, it should be pointed out that a large number of ova from mature specimens of *C. icteridorum* collected from various hosts from various localities have been shown to be consistently smaller than the ova of *C. conspicuum*. *Conspicuum icteridorum* also differs from *C. conspicuum* in having the anterior segment of the body relatively more reduced and the uterus in that portion less extensively developed. The cirrus pouch is relatively larger and extends well behind the intestinal bifurcation in all specimens, and as far as the anterior margin of the acetabulum in many. The gonads are usually rounded though in some old specimens they show a tendency to be slightly lobed.

CONSPICUUM MACRORCHIS, new species

FIGURE 39, c

*Diagnosis.*—Body elongated, rather thick and muscular, 4.27 to 5.47 mm. long by 1.40 to 2.04 mm. wide, widest in region between testes and ovary. Cuticle thick, without spines, longitudinally striated and finely wrinkled transversely, and with retractile sensory papillae, which are visible only on margins of preacetabular region of body. Oral sucker strongly muscular, subterminal, preceded dorsally by a

fairly prominent liplike projection; it measures 0.30 to 0.50 mm. in diameter. Acetabulum large, 0.55 to 0.84 mm. in diameter, muscular, with deep cup-shaped lumen, situated at junction of anterior and middle body thirds. Ratio of diameter of oral sucker to acetabulum 1:1.5 to 1:2. Pharynx globular, 0.14 to 0.24 mm. in diameter. Esophagus short, 0.15 to 0.20 mm. long, somewhat thickened and apparently glandular, bifurcating one-third to one-half the distance from oral sucker to acetabulum. Cecae fairly wide, slightly sinuous, passing dorsal to lateral margins of testes and terminating about one-third the distance from ends of vitellaria to posterior end of body. Excretory system like that of *C. icteridorum*, with the exception that the common collecting tubules pass ventral to inner margins of testes, and these divide into main collecting tubules at ventromedial margins of the male organs. Genital pore median, at about posterior level of pharynx. Testes rounded, large, 0.25 to 0.77 mm. in greatest diameter, situated directly opposite, with zones partly overlapping caudal boundary of acetabular zone. Vasa efferentia arising from anterior margin of testes and passing anteriorly and medially to unite at entrance into cirrus pouch. Cirrus sac elongated oval, 0.33 to 0.66 mm. long by 0.12 to 0.19 mm. wide, usually lying entirely anterior to acetabulum, containing convoluted seminal vesicle, ejaculatory duct surrounded by prostatic gland cells and eversible cirrus. Ovary transversely oval, 0.30 to 0.37 mm. in width, usually situated near middle of body. Seminal receptacle small, located just posterior to ovary. Mehlis' gland medial, just posterior to ovary, at one side of seminal receptacle. Laurer's canal present. Vitellaria composed of numerous medium-sized follicles, mainly extracecal, extending for a distance of 1.73 to 2.28 mm., beginning near anterior level of testes, ending about two-thirds the distance from acetabulum to posterior end of body. Vitelline ducts arising at about middle of the vitellaria. Uterus much convoluted, filling most of posttesticular region of body, then following a wavy course to genital pore. Mature ova dark brown, 27  $\mu$  to 31  $\mu$  long by 19  $\mu$  to 21  $\mu$  wide, fully embryonated when oviposited. Miracidium as in *C. icteridorum*.

*Host*.—*Corvus brachyrhynchos* Brehm.

*Habitat*.—Gall bladder.

*Localities*.—TEXAS: Clodine (type), and Sealey.

*Molluscan host*.—*Bulimulus alternatus mariae* (Albers).

*Type specimen*.—U.S.N.M. Helm. Coll. No. 36747. Additional specimen, No. 36748.

*Remarks*.—*Conspicuum macrorchis* is described from 47 mature specimens from the gall bladder of 4 of 10 crows, *Corvus brachyrhynchos*, examined from Clodine and Sealey, Tex. Individual hosts harbored 6, 8, 8, and 25 worms, respectively. Crows examined from



other localities have failed to yield specimens of this species suggesting that its range coincides with that of the molluscan intermediate host.

*Conspicuum macrorchis* is closely related to *C. icteridorum*, but may be easily distinguished from it by its larger and decidedly more muscular body, its more extensively developed vitellaria and uterus and its conspicuously larger testes.

Genus ZONORCHIS Travassos, 1944

ZONORCHIS ALVEYI (Martin and Gee, 1949), new combination

FIGURE 39, d, e

*Eurytrema alveyi* MARTIN and GEE, Journ. Parasitol., vol. 35, pp. 61-66, 2 figs., 1949.

The material in the present collection, consisting of 48 mature specimens, agrees very closely with that recently described as *Eurytrema alveyi* by Martin and Gee (1949) in size and arrangement of internal organs. Our largest specimens are slightly longer than the original material; they measure 5.42 mm. in length. The "small protuberances" reported on the cuticula of the anterior body region of the type material are conical, retractile, sensory papillae, and are not to be confused with the tuberculations on the cuticle of *Brachylecithum rarum* and *B. tuberculatum*. The acetabulum (fig. 39, e), which is strongly muscular, with a deep cup-shaped lumen, is situated at the junction of the anterior and middle body-thirds. The ratio of the diameter of the oral sucker to acetabulum varies from 1:1.3 to 1:1.5. Not stressed in the original description is the characteristic manner in which the ceca pass dorsal to the medial margins of the testes, forcing these organs against the lateral body walls. The ceca continue posteriorly some distance beyond the testes, medially to the vitellaria. The ovary, which is shallowly but distinctly lobed in all of our specimens, lies slightly to the left of the midline as often as to the right of that line. The uterus, which fills most of the post-acetabular region of the body, forms characteristic anteriorly directed loops between the acetabulum and testes before ascending to the genital pore by a slightly wavy course.

Although the complete excretory system could not be worked out from our specimens, sufficient details could be seen to indicate that the system differs from that described for the type material. In our material the common collecting tubules pass anteriorly and laterally, dorsal to the medial margins of the testes, to bifurcate into anterior and posterior main collecting tubules at the level of the equator of the acetabulum (or dorsal to anterior margins of testes). Each of the anterior main collecting tubules gives rise to three accessory tubules which branch almost immediately into dorsal and ventral



capillary tubules. Of the anterior pair of capillary tubules, one extends straight anteriorly along the oral sucker and the other turns ventrally at right angles along the posterior wall of the sucker. The middle pair of capillaries arises at approximately the posterior level of the cirrus sac; one passes ventrally in an anteromedial direction, the other dorsally and medially toward the posterior end of the cirrus sac. The posterior pair of capillaries arises just a short distance anterior to the junction of the anterior and posterior main tubules; one passes anteromedially toward the anterior margin of the acetabulum while the other one passes medially toward the center of the acetabulum. The origin and number of capillaries arising from the posterior main collecting tubules could not be determined. However, it seems logical that three pairs of capillaries also arise from each of the posterior main collecting tubules, as described for other species of *Dicrocoeliinae*, and that the complete system is very similar to that described for *Conspicuum icteridorum*.

*Zonorchis alveyi* was described originally from specimens from the gall bladder of the slate-colored junco, *Junco hyemalis* (Linnaeus), from the vicinities of Lafayette and Greencastle, Ind. The present paper reports specimens from the gall bladder of the red-eyed towhee, *Pipilo erythrophthalmus* (Linnaeus), from Mountain Lake, Va., Highlands, N. C., and Athens, Ga.; from the white-throated sparrow, *Zonotrichia albicollis* (Gmelin), from Houston, Tex.; from a white-crowned sparrow, *Zonotrichia leucophrys* (Forster), from Athens, Ga.; and from the swamp sparrow, *Melospiza georgiana* (Latham), and a song sparrow, *Melospiza melodia* (Wilson), from Augusta, Ga. Individual birds harbored one to eight worms, four being the average per bird. The red-eyed towhee has been found infected more often than the other hosts and harbored the largest number of worms. Two specimens, No. 36738 from the red-eyed towhee and No. 36739 from the white-throated sparrow, have been deposited in the helminthological collection of the United States National Museum.

We do not agree with Martin and Gee (1949) in assigning this form to the genus *Eurytrema*. The shape of the body, the location of the genital pore (ventral to the pharynx), the nature and extent of the vitellaria, together with the fact that the acetabulum is larger than the oral sucker (about 1.4:1), definitely indicate affinities with members of the genus *Zonorchis* Travassos, 1944. The proper designation of the species, then, is *Zonorchis alveyi* (Martin and Gee, 1949), new combination. In describing *Z. alveyi* (= *Eurytrema alveyi*) the authors compared it only with *Concinnum ludoviciana* (Petri, 1942) Travassos, 1944, a form to which it has only a superficial resemblance. From other species of the genus *Zonorchis*, with which it appears to be more closely related than to species of the genus *Concinnum*, *Z. alveyi*

can be readily distinguished by the manner in which its fairly wide ceca pass medially to the testes and vitellaria, and in having the common collecting tubules of the excretory system pass dorsal to the medial margins of the testes.

**ZONORCHIS PETIOLATUM (Railliet, 1900), new combination**

FIGURE 40, a-d

*Dicrocoelium petiolatum* RAILLIET, Comp. Rend. Soc. Biol., vol. 52, p. 241, 1900.  
*Eurytrema* sp. DENTON, in Petri, Trans. Amer. Micr. Soc., vol. 61, p. 61, 1942.  
*Lyperosomum petiolatum* TRAYASSOS, Monogr. Inst. Oswaldo Cruz, No. 2, pp. 136-137, est. 45, figs. 3-6, 1944.

*Description:* Body spindle-shaped when relaxed, fairly thick and muscular, 2.26 to 4.18 mm. long by 0.34 to 0.92 mm. wide, widest in region between testes and ovary. Cuticle without spines and with small retractile sensory papillae, which are more visible on margins of anterior half of body. Oral sucker muscular, 0.13 to 0.20 mm. in diameter, subterminal in position and preceded dorsally by a fairly prominent liplike projection. Acetabulum muscular, with deep cup-shaped lumen, much larger than oral sucker, 0.25 to 0.40 mm. in diameter, situated within anterior fourth of body. Ratio of diameter of oral sucker to acetabulum varying from 1:1.7 to 1:2.19. Pharynx globular, 0.05 to 0.10 mm. in diameter. Esophagus narrow, usually straight, 0.10 to 0.13 mm. long, surrounded by minute gland cells. Esophagus bifurcating one-half to two-thirds the distance from oral sucker to acetabulum. Ceca slender and slightly sinuous, passing dorsolaterally to margins of testes, terminating approximately one-half the distance from vitellaria to posterior end of body. Excretory pore terminal. Excretory vesicle tubular and voluminous, extending anteriad almost to Mehlis' gland, receiving a common collecting tubule from each side of body. Each common collecting tubule passing anterolaterad to level of equator of testes where it branches into an anterior and posterior main collecting tubule. Genital pore median at about posterior level of pharynx. Testes rounded, 0.09 to 0.20 mm. in greatest diameter, situated directly opposite with zones contiguous or partly overlapping that of acetabulum. Cirrus sac club-shaped, 0.14 to 0.21 mm. long by 0.05 to 0.06 mm. wide, lying entirely in front of or partly dorsal to anterior margin of acetabulum, containing convoluted seminal vesicle, prostatic gland cells, and eversible cirrus. Ovary round to transversely oval, 0.08 to 0.20 mm. in long axis, situated to either right or left side of body, relatively close behind testis on ovarian side of body. Seminal receptacle globular, located dorsal to caudal margin of ovary. Mehlis' gland situated at postero-medial margin of seminal receptacle. Vitellaria composed of numerous medium-sized follicles, extending along lateral margins of body for a distance of 0.85 to 1.32 mm., beginning within testicular zone and

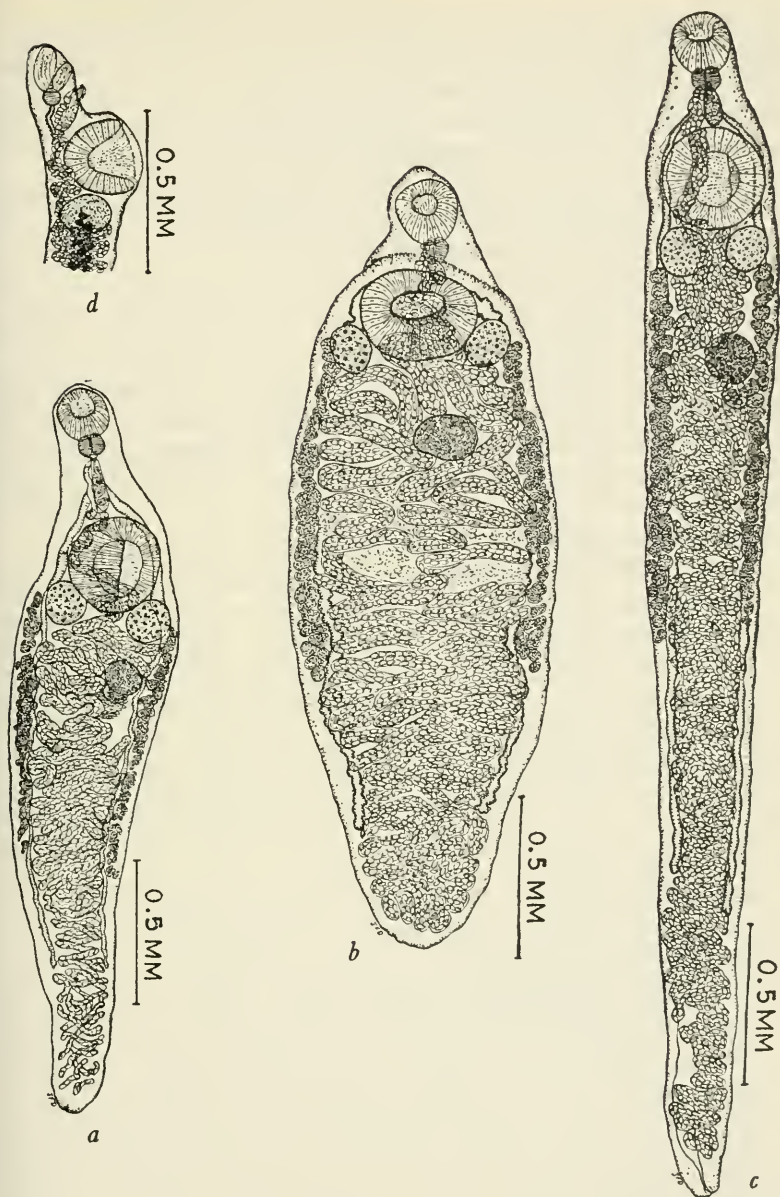


FIGURE 40.—a, *Zonorchis petiolatum* (Railliet, 1900), from the gall bladder of *Cyanocitta cristata*, ventral view, showing relative position of organs and shape of body in relaxed specimen; b, contracted specimen of *Zonorchis petiolatum*, from *Cyanocitta cristata*, showing a resemblance to species of the genus *Platynosomum*; c, extended specimen of *Zonorchis petiolatum*, from *Cyanocitta cristata*, showing a resemblance to certain species of the genus *Lyperosomum*; d, optical sagittal section of anterior end of *Zonorchis petiolatum*, from *Cyanocitta cristata*, showing relative position of organs and deep lumen of acetabulum.



terminating about midway between acetabulum and posterior end of body. Vitelline ducts arising from middle of vitellaria. Uterus greatly convoluted, filling most of postacetabular region of body, then following an undulating course to genital pore. Ova numerous, dark brown when mature,  $30\mu$  to  $36\mu$  long by  $20\mu$  to  $24\mu$  wide.

*Additional hosts*.—*Cyanocitta cristata* (Linnaeus), *Richmondia cardinalis* (Linnaeus), *Hedymeles ludovicianus* (Linnaeus), and *Melanerpes erythrocephalus* (Linnaeus).

*Habitat*.—Liver and gall bladder.

*Localities*. TEXAS: Houston, Dewalt, and Eagle Lake; MISSISSIPPI: State College; NEBRASKA: Lincoln.

Specimens No. 36734 from the blue jay *Cyanocitta cristata*, No. 36735 from the red-headed woodpecker, *Melanerpes erythrocephalus*, and No. 36736 from the cardinal, *Richmondia cardinalis*, have been deposited in the helminthological collection of the United States National Museum.

The above description of *Zonorchis petiolatum* is based on a study of more than 100 living and preserved specimens. Usually the number of worms per host is small, but as many as 75 specimens have been taken from a single blue jay from the vicinity of Houston, Tex. In this locality this trematode seems to be particularly prevalent in the blue jay and cardinal. Numerous blue jays and cardinals examined from other localities by the authors have not been found to be infected.

Railliet (1900) very briefly described under the name of *Dicrocoelium petiolatum* a trematode from the liver of *Garrulus glandarius*, the European jay. The following year Braun (1901) obtained from the same host a trematode that he identified as being identical with that described by Railliet. In the same paper Braun (1901) described a second species, *Dicrocoelium delectans*, from the liver of *Thraupis palmarum*, a South American tanager. Undoubtedly, the incompleteness of Railliet's description of *D. petiolatum*, together with the fact that certain discrepancies between length of body, ratio of sucker sizes, and egg size in the material studied by Braun from the European jay on the one hand, and from the South American tanager on the other, led Braun to redescribe and illustrate these two forms as separate and distinct species in a subsequent paper published in 1902. In this latter paper Braun gave a more complete description of the two forms and materially modified the discrepancies between the two forms as relating to ratio of suckers and size of the egg, thereby bringing these two forms into closer agreement. Braun, however, retained both forms as separate species.

Nicoll (1915) transferred *Dicrocoelium petiolatum* to the genus *Platynosomum* Looss, 1907, while Travassos (1916) considered *D. delectans* a member of this same genus. In 1944 Travassos transferred *D. petiolatum* to the genus *Lyperosomum* Looss, 1899.



Travassos (1922) described under the name *Platynosomum marquesi* a dicrocoeliid from the gall bladder of the same South American tanager, *Thraupis palmarum*. Subsequently, Travassos (1944, p. 159) recorded this species from several other South American birds and declared his species to be synonymous with *D. delectans* Braun. Travassos transferred the species to his newly created genus *Zonorchis*. If Travassos (1944) is justified in considering the material included in his species *marquesi* to be synonymous with *delectans* Braun (and we agree with 'Travassos' decision), the disappearance of the discrepancies between *petiolatum* Railliet and *delectans* Braun as pointed out by Braun (1901, 1902) becomes apparent. It is suggested, therefore, that the material now grouped under the name *Zonorchis delectans* (Braun, 1901) Travassos, 1944, be considered a direct synonym of *Lyperosomum* (= *Dicrocoelium*) *petiolatum* (Railliet, 1900) and that the species be assigned to the genus *Zonorchis*, as *Zonorchis petiolatum* (Railliet, 1900), new combination.

The material in our collection is in perfect agreement with the present concept of the species *Zonorchis petiolatum* (= *Z. delectans* of Travassos). From the material originally described by Railliet (*D. petiolatum*) our material differs in having a smaller body, a smaller sucker ratio, and smaller ova. From *D. petiolatum* as described by Braun our material differs only in having a slightly smaller body. On the other hand, our material conforms very closely with *Zonorchis delectans* (= *Platynosomum marquesi*) of Travassos with the possible exception that the cirrus pouch in our material is slightly smaller.

#### DISTRIBUTION AND TAXONOMIC CONSIDERATIONS

In a recent monograph, Travassos (1944) recognized 25 genera and subgenera with approximately 136 species as comprising the subfamily Dicrocoeliinae Looss, 1899, family Dicrocoeliidae Odhner, 1910. About 84 species belonging to 16 genera and subgenera are recorded from avian hosts throughout the world. The present paper reports the presence of 9 genera and 22 species of dicrocoeliids from North American birds. Three of these species, *Athesmia wehri* McIntosh, 1937, from the prairie sharp-tailed grouse, *Pediocetes phasianellus campestris*, in Montana, *Concinnum* (= *Eurytrema*) *ludoviciana* (Petri, 1942) from the rose-breasted grosbeak, *Hedymeles ludovicianus*, in Nebraska, and *Platynosomum* (= *Dicrocoelium*) *illiciens* (Braun, 1901) from the broad-winged hawk, *Buteo platypterus*, in Ohio and Wisconsin, have not been studied by us. Of the remaining 19 species of dicrocoeliids from North American bird hosts 10 are described as new. The hosts, geographic distribution, and authority

for the 22 species recorded from North American birds are given in table 1.

Insofar as the over-all taxonomy of the Dicrocoeliinae is concerned it is here important only to point out certain duplication of taxonomic effort that has appeared in the literature within recent years. In studying a section of the subfamily, Bhalerao (1936) suggested that the then 17 valid species assigned to the genus *Eurytrema* Looss, 1907, showed characters sufficiently distinct for their separation into five subgenera. The names *Pancreaticum*, *Concinnum*, *Conspicuum*, and *Skrjabinus* in addition to *Lubens*, suggested by Travassos in 1920, were proposed for these five subgenera. For the characters on which this separation was made the reader is referred to Bhalerao's original paper.

Strom (1940), in working with dicrocoeliid trematodes from Eurasian hosts, accepted Bhalerao's division of the genus *Eurytrema* but elevated the subgenera *Lubens*, *Conspicuum*, *Concinnum*, and *Skrjabinus* to generic rank. He accepted the first three of these subgenera as defined by Bhalerao and retained the species as allocated in the original paper, although transferring a more recently described species, *Eurytrema epomopis* Sandground, 1937, to the genus *Concinnum*. After restudying the species *Eurytrema skrjabinus* Isiatshikoff, 1920, and *E. koschewnikowi* Skrjabin and Massino, 1925, the only two species included in the subgenus *Skrjabinus* by Bhalerao, Strom redefined the genus to include forms in which (1) the genital pore is ventral to or near the pharynx; (2) the vitellaria occupy the lateral margins of the body and extend from the region of the acetabulum (or behind this level) to a point considerably beyond the ovary; and (3) the uterus has numerous loops occupying the whole body posterior to the acetabulum. Strom described 5 new species, which he assigned to the genus *Skrjabinus*.

In the same paper, Strom (1940) proposed a revision of the genus *Lyperosomum* Looss, 1899, which now contained more than 50 species and subspecies. Three genera, *Lyperosomum* (*sensu stricto*), *Brachylecithum*, and *Corrigia*, were proposed for the reception of this assemblage of species. *Lyperosomum longicauda* (Rudolphi, 1809) was designated the type of the genus *Lyperosomum*, and the genus was restricted to those forms which showed (1) elongated bodies, the anterior end of which tapered more abruptly than did the posterior end; (2) subequal, muscular suckers, of which the acetabulum is the larger; (3) ceca ending in advance of the caudal extremity of the body; (4) testes oblique or symmetrical and close behind the acetabulum; (5) genital pore near the midline, at the posterior level of the pharynx; and (6) vitellaria consisting of numerous small follicles which extend from the zone of the testes to a level far short

of the caudal extremity. Strom retained 12 species in the genus *Lyperosomum*.

In the second genus, *Brachylecithum*, Strom (1940) placed 25 species and 3 varieties formerly assigned to the genus *Lyperosomum*. The species *filum* (Dujardin, 1845) was designated as the type of the new genus. The generic group was briefly characterized as (1) possessing vitellaria composed of relatively few large follicles which occupied a small area just posterior to the ovary; (2) genital pore in the midline, ventral to the intestinal bifurcation; and (3) either one or two intestinal ceca which fail to reach the caudal end of the body. *Brachylecithum* (= *Lyperosomum*) *filum* was redescribed and figured. The species was represented as having branched intestinal ceca.

The third genus, *Corrigia*, proposed by Strom (1940) for species previously included in *Lyperosomum*, carried *Corrigia* (= *Lyperosomum*) *corrigia* (Braun, 1901) as the type. The group showed the following characters: (1) Body long and semitransparent; (2) weakly muscular suckers of approximately the same size; (3) two intestinal ceca which almost reach the caudal tip of the body; (4) genital pore ventral to or just posterior to the intestinal bifurcation; and (5) vitellaria consisting of numerous small follicles extending from the region of the ovary to a level behind the middle of the body. Four other species were assigned to the genus.

Travassos (1919) created the genus *Oswaldoia* for the reception of his species *oswaldoi* and transferred *Dicrocoelium skrjabinus* Solowow, 1913, and *Lyperosomum direptum* Nicoll, 1914, to that genus. Since the erection of the genus several additional species have been described and assigned to *Oswaldoia* by various authors. Strom (1940) accepted Travassos' diagnosis of *Oswaldoia* and retained it as a valid genus for the species *O. oswaldoi* Travassos, 1919, *O. marquesi* (Travassos, 1922), *O. petiolatum* (Railliet, 1900), *O. direptum* (Nicoll, 1914), and *O. pawlowskyi* (Strom, 1928). Later, Travassos (1941b) erected the genus *Lutztrema* for the reception of those members of the genus *Lyperosomum* which possessed but a single cecum. In the genus, Travassos included the species formerly known as *Lyperosomum obliquum* Travassos, 1917, *L. transversum* Travassos, 1917, and *L. monenteron* Price and McIntosh, 1935, as well as three new species, *L. marinkholutzi*, *L. verrucosum*, and *L. insigne*. On the basis of published figures alone Travassos provisionally includes several other species in his genus *Lutztrema*.

Being unaware of the paper published by Strom in 1940, Travassos (1944) elevated the subgenera *Concinnum* and *Conspicuum* of Bhallerao (1936) to generic rank. This writer, however, retained *Lubens* and *Skrjabinus* as subgenera of the genus *Eurytrema*. As defined by Travassos the genus *Conspicuum* is identical with the genus *Skrjabinus* as diagnosed by Strom. It is possible, therefore, to declare these



two genera to be synonyms of each other. Since the name *Conspicuum* appears first in the original paper by Bhalerao, the proper designation of the genus is *Conspicuum*, and all species assigned to the genus *Skrjabinus* must be transferred to it.

Travassos (1944) recognized the unwieldiness of the assemblage of species assigned to the genus *Lyperosomum* Looss, 1899. Being unaware of the separation of the genus into three genera by Strom in 1940, Travassos proposed the genera *Olssoniella* and *Orthorchis* in addition to the genus *Lyperosomum* for the reception of this group of species. Travassos designated the species *longicauda* of Rudolphi, 1809, as the type of the genus *Lyperosomum*, and characterized the members of the genus in an almost identical way to that proposed by Strom. He further declared his genus *Oswaldoia* (1919) to be a direct synonym of *Lyperosomum* and transferred those species assigned to that genus to *Lyperosomum*. Sixteen species were listed as belonging to the genus.

For a second group of species formerly included in the genus *Lyperosomum*, Travassos (1944) erected the genus *Olssoniella*, with *O. olssoni* (Railliet, 1900) as the type. The genus *Olssoniella* is readily recognized as being identical with the genus *Brachylecithum* Strom, 1940. This identity is further evidenced by the fact that the species *filum*, the designated type of the genus *Brachylecithum*, is recognized as being congeneric with the species *olssoni* by its inclusion in the list of species given for the genus *Olssoniella* by Travassos. Travassos included 19 species in the genus *Olssoniella*. These species are hereby recognized as belonging to the genus *Brachylecithum*.

For the reception of a third group of species previously included in the genus *Lyperosomum*, Travassos (1944) erected the genus *Orthorchis*. *Orthorchis* (= *Lyperosomum*) *lari* (Travassos, 1917) was designated as the type, while six additional species were assigned to the genus. Among these species appears *corrigia* of Braun, 1901, the type species of the genus *Corrigia* as created by Strom, 1940. The quite similar diagnoses for the two genera (*Corrigia* and *Orthorchis*) together with the recognized congeneric relationship of the two type species renders the genus *Orthorchis* Travassos, 1944, a synonym of *Corrigia* Strom, 1940, and hence necessitates the transfer of the species included in the genus *Orthorchis* by Travassos to the genus *Corrigia*.

We have no hesitancy in restricting the genus *Eurytrema* to those species now allocated to that genus by Bhalerao, 1936, Strom, 1940, and Travassos, 1944. As emended by Strom, 1940, we recognize the genus *Lubens* Travassos, 1920. The genera *Concinnum* Bhalerao, 1936, as emended by Travassos, 1944, and *Conspicuum* (= *Skrjabinus*) Bhalerao, 1936, as emended by Strom, 1940, and Travassos, 1944, constitute valid generic groups. Furthermore, we recognize the genus



*Zonorchis* Travassos, 1944, as a valid genus for the reception of certain species formerly included in the genera *Eurytrema* and *Platynosomum*, with the members of the genus *Zonorchis* differing from the remaining species of their respective generic groups in (1) the relatively large acetabulum in comparison to the size of the oral sucker; (2) the more forward position of the genital pore; and (3) the extent and rounded rather than dendritic follicles of the vitellaria.

 TABLE 1.—*Distribution of microcoeliids in North American birds*

HOST	TREMATODE	LOCALITY	REFERENCE
Accipitridae:			
<i>Buteo lineatus</i> .....	<i>Brachylecithum americanum</i> .	Georgia.....	This paper.
<i>Buteo platypterus</i> .....	<i>Platynosomum illiciens</i> .....	Ohio; Wisconsin .....	Denton and Rausch, 1949.
Tetraonidae:			
<i>Pediocetes phasianellus campestris</i> .	<i>Athesmia wehri</i> .....	Montana.....	McIntosh, 1937.
<i>Bonasa umbellus</i> .....	<i>Lutztrema monenteron</i> (?) ..	Minnesota.....	Ishii, 1942.
Gruidae:			
<i>Grus canadensis stabida</i> .	<i>Brachylecithum gruis</i> .....	Texas.....	This paper.
Rallidae:			
<i>Gallinula chloropus cachinnans</i> .	<i>Athesmia heterolecithodes</i> ..	Tennessee.....	This paper.
Strigidae:			
<i>Bubo virginianus</i> .....	<i>Brachylecithum moorei</i> .....	Texas (?).....	This paper.
Picidae:			
<i>Melanerpes erythrocephalus</i> .	<i>Zonorchis petiolatum</i> .....	Mississippi.....	This paper.
Tyrannidae:			
<i>Tyrannus tyrannus</i> .....	<i>Lutztrema monenteron</i> (?) ..	Minnesota.....	Ishii, 1942.
Corvidae:			
	<i>Lyperosomum oswaldoi</i> .....	Texas.....	This paper.
	<i>Lutztrema microstomum</i> .....	North Carolina; Georgia; Texas.	This paper.
<i>Cyanocitta cristata</i> .....	<i>Brachylecithum americanum</i> .	Georgia.....	Denton, 1945.
	<i>Brachylecithum stunkardi</i> ..	Virginia; Texas.....	This paper.
	<i>Zonorchis petiolatum</i> .....	Texas.....	This paper.
	<i>Brachylecithum americanum</i> .	Georgia.....	Denton, 1945.
<i>Corvus brachyrhynchos</i> .	<i>Conspicuum macrorchis</i> .....	Texas.....	This paper.
Mimidae:			
<i>Mimus polyglottos</i> .....	<i>Lutztrema monenteron</i> .....	Georgia; Texas.....	This paper.
	<i>Lyperosomum oswaldoi</i> .....	Georgia; Mississippi; Texas.	This paper.
<i>Torostoma rufum</i> .....	<i>Lutztrema monenteron</i> .....	Virginia.....	This paper.
	<i>Brachylecithum exochocotyle</i>	Georgia.....	This paper.
Turdidae:			
		Virginia; Washington, D. C.; Quebec, Canada.	Price and McIntosh, 1935.
<i>Turdus migratorius</i> .....	<i>Lutztrema monenteron</i> .....	Virginia; North Carolina; Georgia; Ohio; Tennessee; Texas.	This paper.
<i>Sialia s. sialis</i> .....	<i>Lutztrema monenteron</i> .....	Virginia.....	Price and McIntosh, 1935.

TABLE 1.—*Distribution of dicrocoeliids in North American birds—Continued*

HOST	TREMATODE	LOCALITY	REFERENCE
Parulidae:			
<i>Seiurus aurocapillus</i> ...	<i>Brachylecithum seiuricum</i> ...	Virginia.....	This paper.
<i>Wilsonia canadensis</i> ...	<i>Brachylecithum tuberculatum</i> .	Virginia.....	This paper.
Icteridae:			
<i>Sturnella magna argutula</i> .	<i>Brachylecithum americanum</i> .	Texas.....	Denton, 1945.
	<i>Conspicuum icteridorum</i> ...	Texas; Georgia.....	This paper.
<i>Euphagus carolinus</i> ...	<i>Conspicuum icteridorum</i> ...	Texas.....	This paper.
<i>Cassidix mexicanus major</i> .	<i>Conspicuum icteridorum</i> ...	Texas.....	This paper.
<i>Cassidix mexicanus prosopidicola</i> .	<i>Brachylecithum americanum</i> .	Texas.....	Denton, 1945.
	<i>Lubens lubens</i> .....	Texas.....	This paper.
	<i>Conspicuum icteridorum</i> ...	Texas.....	This paper.
<i>Quiscalus quiscula quiscula</i> .	<i>Conspicuum icteridorum</i> ...	Georgia.....	This paper.
<i>Quiscalus quiscula aeneus</i> .	<i>Brachylecithum americanum</i> .	Tennessee; Texas.....	Denton, 1945.
	<i>Conspicuum icteridorum</i> ...	Michigan; Tennessee; Texas.	This paper.
Thraupidae:			
<i>Piranga olivacea</i> .....	<i>Lubens lubens</i> .....	Virginia.....	This paper.
Fringillidae:			
<i>Richmondia cardinalis</i> .	<i>Zonorchis petiolatum</i> .....	Texas.....	This paper.
<i>Hedymeles ludovicianus</i> .	<i>Concinnum ludovicianae</i> ...	Nebraska.....	Petri, 1942.
	<i>Zonorchis petiolatum</i> .....	Nebraska.....	This paper.
	<i>Brachylecithum rarum</i> .....	Virginia; North Carolina.	This paper.
<i>Pipilo erythrophthalmus</i> .	<i>Brachylecithum nanum</i> .....	Virginia; North Carolina.	This paper.
	<i>Brachylecithum delicatum</i> ...	North Carolina.....	This paper.
	<i>Zonorchis alveyi</i> .....	Virginia; North Carolina; Georgia.	This paper.
<i>Junco hyemalis</i> .....	<i>Zonorchis alveyi</i> .....	Indiana.....	Martin and Gee, 1949.
<i>Zonotrichia leucophrys</i> .	<i>Zonorchis alveyi</i> .....	Georgia.....	This paper.
<i>Zonotrichia albicollis</i> .	<i>Brachylecithum nanum</i> .....	Georgia; Texas.....	This paper.
	<i>Zonorchis alveyi</i> .....	Texas.....	This paper.
<i>Melospiza georgiana</i> ...	<i>Zonorchis alveyi</i> .....	Georgia.....	This paper.
<i>Melospiza melodia</i> ...	<i>Zonorchis alveyi</i> .....	Georgia.....	This paper.

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THE MITES OF THE SUBFAMILY HAEMOGAMASINAE  
(ACARI: LAELAPTIDAE)

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THIS paper comprises a general review of the distribution, classification, and external morphology of the parasitic mites of the subfamily Haemogamasinae Oudemans, 1926. It is based largely on material in the United States National Museum, although numerous specimens from other sources were also examined. In the descriptions that follow, all specimens examined are in the National Museum unless otherwise indicated.

None of the Haemogamasinae has been reported as a vector of disease, although several species of related subfamilies of Laelaptidae serve as vectors of virus and rickettsial disease agents, as well as of nematode and protozoan parasites of mammals, birds, and reptiles. Many laelaptid mites, normally parasites of rodents and birds, have been reported to attack man, causing dermatitis. Hill and Gordon (1945) reported that *Eruhaemogamasus oudemansi*, along with several other species of mites, may have been responsible for an outbreak of

<sup>1</sup> I am under obligation to many persons who contributed specimens, supplied collecting data, and extended other courtesies that were of great value in preparing this paper. Officials of the United States National Museum furnished facilities for study during the spring of 1946 and in addition lent me its entire collection of Haemogamasinae for nearly 2 years. I am especially indebted to Dr. L. O. Nolf, State University of Iowa, under whose direction this study was made; Dr. E. W. Baker, U. S. Bureau of Entomology and Plant Quarantine, who gave valuable advice, supplied numerous specimens, and obtained photostat copies of several otherwise inaccessible references; Dr. H. E. Ewing, Washington, D. C.; E. W. Jameson, Jr., University of California, Davis, Calif.; Dr. C. L. Remington, Harvard University Biological Laboratories, Cambridge, Mass.; Dr. R. W. Strandtmann, Jr., University of Texas Medical Branch, Galveston, Tex.; Dr. J. M. Linsdale, Museum of Vertebrate Zoology, University of California; H. B. Morlan, U. S. Public Health Service, Thomasville, Ga.; Dr. F. A. Turk, Camborne, England; Dr. C. D. Radford, British Museum, London; and Dr. Arve H. Dahl, State of California Department of Health.

60 cases of dermatitis that occurred among American troops serving in North Wales during the war. The mites, in this instance, were present in straw-filled mattresses upon which the men were sleeping.

### TAXONOMIC POSITION

Mites of the subfamily Haemogamasinae<sup>2</sup> are parasites on small mammals, occasionally free living or on birds. Dorsal shield undivided in both sexes and in larval and nymphal stages. Anterior margin of epistome with simple or branching fimbriae. Body setae more numerous than in other laelaptid mites. Legs with spurs only in genus *Ischyropoda*. Sternal shield with accessory setae in genera *Haemogamasus* and *Ischyropoda*. Genitoventral shield of nymphal stages with accessory setae only in genus *Ischyropoda*. Accessory anal setae present in almost all specimens of most species. Anal shield separate in males of genus *Ischyropoda*. Metapodal shields small. Three genera. Distribution cosmopolitan.

The Haemogamasinae were given status as a subfamily not upon basis of adult characteristics alone, but primarily because larval and nymphal stages, as well as adults, possess only a single dorsal shield. In most other genera of Laelaptidae the dorsal shields develop in such a way that, whether single or divided in the adult, the protonymph possesses an anterior pronotal shield and a posterior pygidial shield, between which are smaller, intermediate shields, which differ in number in various genera. The phylogenetic importance of the nature of the dorsal shield was advanced by Trägårdh (1911), who regarded possession of two shields as a primitive feature, retained in more recent genera only in the nymphal stages. Oudemans erected the family Haemogamasidae in 1926, and although Vitzthum first (1931) agreed with this interpretation he later (1942) reduced the group to status of one of the 13 subfamilies included by him in the Laelaptidae *sensu lato*.

Prior to this study the following genera and species of Haemogamasinae were recognized:

#### Genus HAEMOGAMASUS Berlese, 1889

1889. <i>H. hirsutus</i> Berlese	1925. <i>H. alaskensis</i> Ewing
1892. <i>H. horridus</i> Michael	1925. <i>H. barberi</i> Ewing
1892. <i>H. nidi</i> Michael	1925. <i>H. microti</i> Ewing
1905. <i>H. americanus</i> Banks	1925. <i>H. twitchelli</i> Ewing
1914. <i>H. oudemansi</i> Hirst	1926. <i>H. quadrisetatus</i> Vitzthum
1915. <i>H. sanguineus</i> Ewing and Stover	1931. <i>H. avisugus</i> Vitzthum
1916. <i>H. liberiensis</i> Hirst	1931. <i>H. mandschuricus</i> Vitzthum
1920. <i>H. arvicolarum</i> (Berlese)	1933. <i>H. sternalis</i> Ewing

<sup>2</sup> Order Acari Leach, 1817; suborder Parasitiformes Reuter, 1909; supercohort Mesostigmata Canestrini, 1891; cohort Gamasidea Leach, 1815; subcohort Gamasina Kramer, 1885; family Laelaptidae Berlese, 1892.



## Genus ACANTHOCHELA Ewing, 1933

1933. *A. chilensis* Ewing

## Genus EUHAEMOGAMASUS Ewing, 1933

- |                                       |                                    |
|---------------------------------------|------------------------------------|
| 1925. <i>E. reidi</i> (Ewing)         | 1933. <i>E. oregonensis</i> Ewing  |
| 1925. <i>E. liponyssoides</i> (Ewing) | 1933. <i>E. utahensis</i> Ewing    |
| 1933. <i>E. onychomydis</i> Ewing     | 1946. <i>E. sciuropteri</i> Keegan |

Genera and species of Haemogamasinae herein recognized as valid are as follows:

## Genus HAEMOGAMASUS Berlese, 1889

- |                                   |                                       |
|-----------------------------------|---------------------------------------|
| 1889. <i>H. hirsutus</i> Berlese  | 1931. <i>H. avisugus</i> Vitzthum     |
| 1916. <i>H. liberiensis</i> Hirst | 1931. <i>H. mandshuricus</i> Vitzthum |
| 1925. <i>H. alaskensis</i> Ewing  | 1951. <i>H. harperi</i> , new species |

## Genus EUHAEMOGAMASUS Ewing, 1933

- |                                       |   |
|---------------------------------------|---|
| 1872. <i>E. ambulans</i> (Thorell)    | 1925. <i>E. barberi</i> (Ewing)                             |
| 1892. <i>E. horridus</i> (Michael)    | 1926. <i>E. quadrisetatus</i> (Vitzthum)                    |
| 1914. <i>E. oudemansi</i> (Hirst)     | 1951. <i>E. liponyssoides occidentalis</i> , new subspecies |
| 1925. <i>E. liponyssoides</i> (Ewing) |   |

## ISCHYROPODA, new genus

1951. *I. spiniger*, new species  
 1951. *I. armatus*, new species

The foregoing lists reflect changes in status of several species, deletion of one genus from the subfamily, and addition of four new species and one new genus.

1. Oudemans (1913) and Vitzthum (1931) doubted that *H. americanus* Banks, 1905, and *H. sanguineus* Ewing and Stover, 1915, were actually members of genus *Haemogamasus*. Examination of type material supported their views, as the type of *H. americanus* proved to be a specimen of *Liponyssus* and that of *H. sanguineus* to be an undetermined member of the same genus.

2. *E. utahensis* Ewing, 1933, lacks the fimbriate epistome of the Haemogamasinae and, because of its distinctly abbreviated sternal shield, will be redescribed elsewhere as representing a new genus of Laelaptidae.

3. Several instances of synonymy are corrected: (a) *H. horridus arvicolarum* Berlese, 1920, redescribed as *H. arvicolarum* (Berlese) by Turk (1945), is considered a synonym of *E. horridus* (Michael, 1892); (b) *H. sternalis* Ewing, 1933, is considered a synonym of *H. alaskensis* Ewing, 1925; (c) *H. microti* Ewing, 1925, is considered a synonym of *E. barberi* (Ewing, 1925); and (d) *H. nidi* Michael, 1892, *H. twitchelli* Ewing, 1925, *E. reidi* (Ewing, 1925), *E. onychomydis* Ewing, 1933, *E. oregonensis* Ewing, 1933, and *E. sciuropteri* Keegan, 1946, are considered synonyms of *E. ambulans* (Thorell, 1872), which is here transferred from *Eulaelaps* Berlese, 1903, to the genus *Euhaemogamasus*.

4. The genus *Haemogamasus* is distinguished from *Euhaemogamasus* only in that its species possess accessory sternal setae. As each of the following possess only the usual sternal setae, they are here transferred to genus *Euhaemogamasus*: *H. horridus* Michael, 1892; *H. oudemansi* Hirst, 1914; *H. quadrisetatus* Vitzthum, 1926; and *H. barberi* Ewing, 1925.

5. *H. harperi* and *E. liponyssoides occidentalis* are described as new.

6. The new genus *Ischyropoda* is proposed, and *I. spiniger* and *I. armatus* are described as new species.

7. Original descriptions are given of the male and nymph of *H. alaskensis* and *E. barberi* as well as the nymph of *E. liponyssoides*. The male of the latter species has never before been figured.

8. In my opinion there is not sufficient evidence to indicate that *Acanthochela chilensis* Ewing, 1933, should be placed in the Haemogamasinae. This species was described from four female specimens taken from an opossum at Lota, Chile, in 1929, and it has not been collected since. Condition of the specimens on the type slide is such that it is impossible to determine the structure of the epistome or chelicerae. Because of this, and as there are no males, nymphs, or larvae available for study, it is proposed that the genus and species be transferred to the subfamily Laelaptinae Trägårdh, 1908, where setation of the sternal shield alone would serve as a distinguishing characteristic.

#### MORPHOLOGY

Each species description in their paper is based upon a study of several aspects of morphology common, in general, to all members of the subfamily.

1. *Dorsal shield*.—Nearly covers dorsal surface in most species; setae, present over entire surface of shield, are usually larger in apical region, where a pair of conspicuously large *apical setae* is present on the anterior margin of the shield; setae may vary in size and number and may be smooth or barbed; several pairs of *dorsal pores* may be present near the margins of the shields; fine reticulations on the shield produce the effect known as *sculpturing*.

2. *Dorsal body setae*.—Those setae lateral and posterior to the dorsal shield; frequently larger and more often barbed than setae of shield; usually largest at posterior body margin, where two or three pairs may be conspicuously long.

3. *Tritosternum*.—Shows little variation; lacinae may be smooth or barbed.

4. *Presternal area*.—Sculptured, with transverse sutures, which in some species possess tiny, posteriorly directed spines.

5. *Sternal shield*.—Usually distinctively sculptured; with at least three pairs of *usual sternal setae* in all genera; species of *Haemogamasus* and *Ischyropoda* possess *accessory sternal setae*, which are nearly always smaller than the usual setae, and vary in size, number, and position on shield; both usual and accessory setae may be barbed; two pairs of *sternal pores* in all species; a third pair may border the posterior margin of the shield in some instances; size and position of pores vary specifically; shape of shield varies considerably; its posterior margin in particular may be nearly straight or invaginated in varying degrees.

6. *Genitoventral shield*.—Usually bulb-shaped, with a rounded posterior margin, but varies in size and shape, and in a few species possesses nearly parallel lateral margins; with a pair of *usual genitoventral setae* and varying numbers of *accessory setae*, which are often distinctly smaller and vary in size and position on the shield; both usual and accessory setae may be smooth or barbed; sculpturing not as distinct as on sternal shield.

7. *Anal shield*.—Roughly triangular in outline, with a rounded anterior margin, but subject to specific variation; its lateral margins may be parallel; three *usual anal setae* always present and always the most posterior setae on shields; *accessory anal setae* vary in number specifically and individually; they also vary in size and position on shield; anal setae may be smooth or barbed.

8. *Endopodal shields*.—Slender; show little variation.

9. *Metapodal shields*.—Small; show little variation.

10. *Ventral body setae*.—Present over ventral surface of body exclusive of shields and coxae; vary in size and number and may be smooth or barbed; usually longest at posterior body margin; there is a pair of *metasternal setae* about equal in size with posterior usual sternal setae.

11. *Peritreme*.—Shape of peritremal shield, particularly its posterior end, which encloses the *spiracle* or *stigma*, varies specifically; location of *pores*, posterior to stigma, also varies specifically.

12. *Epistome*.—Anterior margin of epistome fimbriated; varies in outline specifically; *fimbriae* may be simple or branched and vary in number.

13. *Chelicerae*.—*Chelae* may possess or lack teeth, and they vary specifically; *fixed chela* may possess a distal and a proximal seta, as well as a proximal brush or fringe of small setae; the distal seta, when stout, is termed an *inflated seta*; when small and slender it is termed a *pilus dentilis*; the pili are usually present on species whose chelae lack teeth.

14. *Maxillary corniculi*.—Vary specifically in outline; that feature and the position and relative size of the four pairs of *maxillary setae*

are the most easily studied aspects of the ventral surface of the gnathosoma (Fig. 41.)

15. *Palpi*.—Each composed of six segments: *coxa*, *trochanter*, *femur*, *genu*, *tibia*, and *tarsus*; pattern of setation appears to be nearly

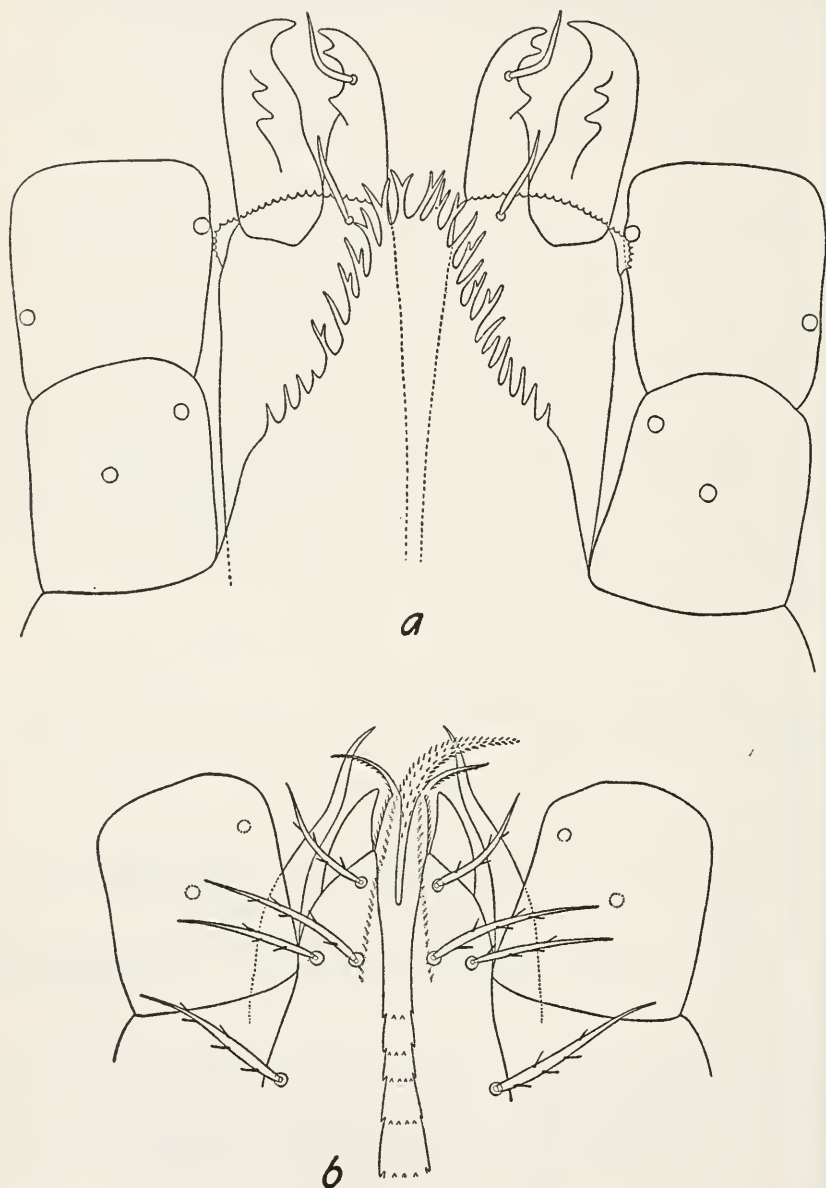


FIGURE 41.—Taxonomically important mouth parts of the Haemogamasinae: *a*, Dorsal view of the gnathosoma of a female of *Euhaemogamasus ambulans* (Thorell) showing epistome and chelicerae; *b*, ventral view of the gnathosoma of a female of *E. ambulans* showing maxillary corniculi and setae.



identical in all species of Haemogamasinae; the large, bifurcate, tarsal seta is a characteristic of the Laelaptidae; all species possess a conspicuously stout seta on ventral surface of coxa; setae may be smooth or barbed and are usually stouter on ventral surface of palp.

16. *Legs*.—Possess six segments as in palpi; vary specifically in nature of setation and to some extent in relative thickness; setae may be smooth or barbed and are usually shorter and thicker on the ventral surface of each leg; length-width ratio of tarsus varies specifically; distal margins of segments with spines in some species; spurs present on legs of species of *Ischyropoda*.

17. *Male*.—Sexual dimorphism apparent in several respects; usually smaller than female and with a relatively larger dorsal shield. In *Haemogamasus* and *Euhaemogamasus* a single *ventral shield* includes regions covered by sternal, genitoventral, anal, endopodal, and metapodal shields of female; in *Ischropoda* the anal shield is separate, as are the endopodal and metapodal shields. Setation and position of pores on ventral shield correspond fairly closely with those of the female of each species; shape of shield varies specifically. Epistome usually as in female, but in some species may differ slightly. Chelae modified in most species; dimorphism especially apparent in movable chela, which, according to Michael (1892), serves to transport the spermatophore from the genital aperture of the male to that of the female. Maxillary corniculi frequently blunt rather than pointed as in the female. Legs may be relatively stouter than in the female and may bear conspicuously stout ventral setae or spurs, especially on leg II; Michael (1892) reported that these enabled the male to clutch the female more firmly during copulation. In spite of sexual dimorphism, the males of each species may be readily determined by characteristics common to both sexes.

18. *Larval and nymphal stages*.—Dorsal shield undivided, but with a slitlike invagination on either lateral margin at the level of coxae IV in several species. Ventral body surface with an anal shield and a ventral shield extending from coxae I to coxae IV; in most species this shield possesses four pairs of setae, which represent the three pairs of usual sternal setae and the single pair of metasternal setae of the adult. The usual genitoventral setae flank the narrow, bluntly pointed, posterior end of the shield in most species; accessory setae are present on the ventral shield only in genus *Ischyropoda*; anal shield as in female but usually with fewer accessory setae. Peritremal shield not fully developed. Epistome, chelae, and maxillae are very much as in adult female and offer most easily studied means of identification. Palpi and legs often relatively stouter than in adults. Setae as in adults but may be relatively smaller and less numerous.

## Genus HAEMOGAMASUS Berlese

*Haemogamasus* BERLESE, Acari, Myriopoda et Scorpiones hucusque in Italia reperta: Mesostigmata, fasc. 52, Nos. 2 and 10, 1889.—EWING, Proc. Biol. Soc. Washington, Vol. 38, p. 137, 1925; Proc. U. S. Nat. Mus., vol. 82, art. 30, p. 2, 1933.—VITZTHUM, Treubia, vol. 8, p. 53, 1926; Zool. Jahrb. (Abt. Syst.), vol. 60, pp. 393–405, 1931. (Genotype: *Haemogamasus hirsutus* Berlese, 1889.)

Sternal shield with accessory setae; legs without spurs; male without a separate anal shield; ventral shield of nymph without accessory setae.

## KEY TO FEMALES OF GENUS HAEMOGAMASUS

1. All setae smooth; chelae toothless----- 2  
     With some barbed setae, chelae with teeth----- 3
2. At least 2 pairs of accessory setae on anterior margin of sternal shield;  
     anterior pair of sternal pores on level of anterior pair of usual sternal  
     setae----- *hirsutus* Berlese (p. 210)  
     No accessory setae on anterior margin of sternal shield; anterior pair of  
     sternal pores distinctly posterior to anterior pair of usual sternal setae  
     ----- *harperi*, new species (p. 223)
3. Movable chela with 1 tooth; usual sternal setae no larger than accessory  
     setae----- *avisugus* Vitzthum (p. 222)  
     Movable chela with 2 teeth; usual sternal setae distinctly larger than  
     accessory setae----- 4
4. No accessory setae on anterior fourth of sternal shield.  
     ----- *mandschuricus* Vitzthum (p. 218)  
     At least 1 pair of accessory setae on anterior margin of sternal shield----- 5
5. All usual sternal setae barbed; 2 pairs of accessory setae on anterior mar-  
     gin of sternal shield----- *liberiensis* Hirst (p. 221)  
     Only anterior pair of usual sternal setae barbed; 1 pair of accessory  
     setae on anterior margin of sternal shield----- *alaskensis* Ewing (p. 213)

## HAEMOGAMASUS HIRSUTUS Berlese

## FIGURE 42

*Haemogamasus hirsutus* BERLESE, Acari, Myriopoda et Scorpiones hucusque in Italia reperta: Mesostigmata, fasc. 52, No. 2, pp. 117–118, table 125, 1889.—OUDEMANS, Arch. Naturg., vol. 79, Abt. A, Heft 8, pp. 138–146, figs. 82–97, table 2; figs. 1–10, table 8; figs. 6–11, 1913.—HIRST, Journ. Zool. Res., vol. 1, p. 59, 1916.—EWING, Proc. Biol. Soc. Washington, vol. 38, p. 138, 1925.—VITZTHUM, Zool. Jahrb., vol. 60, p. 396, 1931.

*Female*.—Dorsal shield decidedly pointed posteriorly in available specimens. In addition to the two usual apical setae at least five smaller setae on apical margin. Shield densely covered with setae, which are  $9\mu$  to  $15\mu$  apart; large and small setae interspersed on shield; smaller setae more numerous and about  $45\mu$  in length; larger setae about  $90\mu$  in length; all setae smooth. Shield surface granulated in appearance but not sculptured. Setae of unprotected integument of dorsal surface larger than those on shield, longest at posterior body margin, all smooth. Lacinae of tritosternum faintly barbed. Pre-sternal area sculptured but with only faint indications of spines.

Sternal shield with usual sternal setae and about 30 accessory setae (24 to 32 in the five specimens examined). Accessory setae variable in size and larger near the anterior and posterior margins of the shield. Two pairs of accessory setae on anterior margin of shield

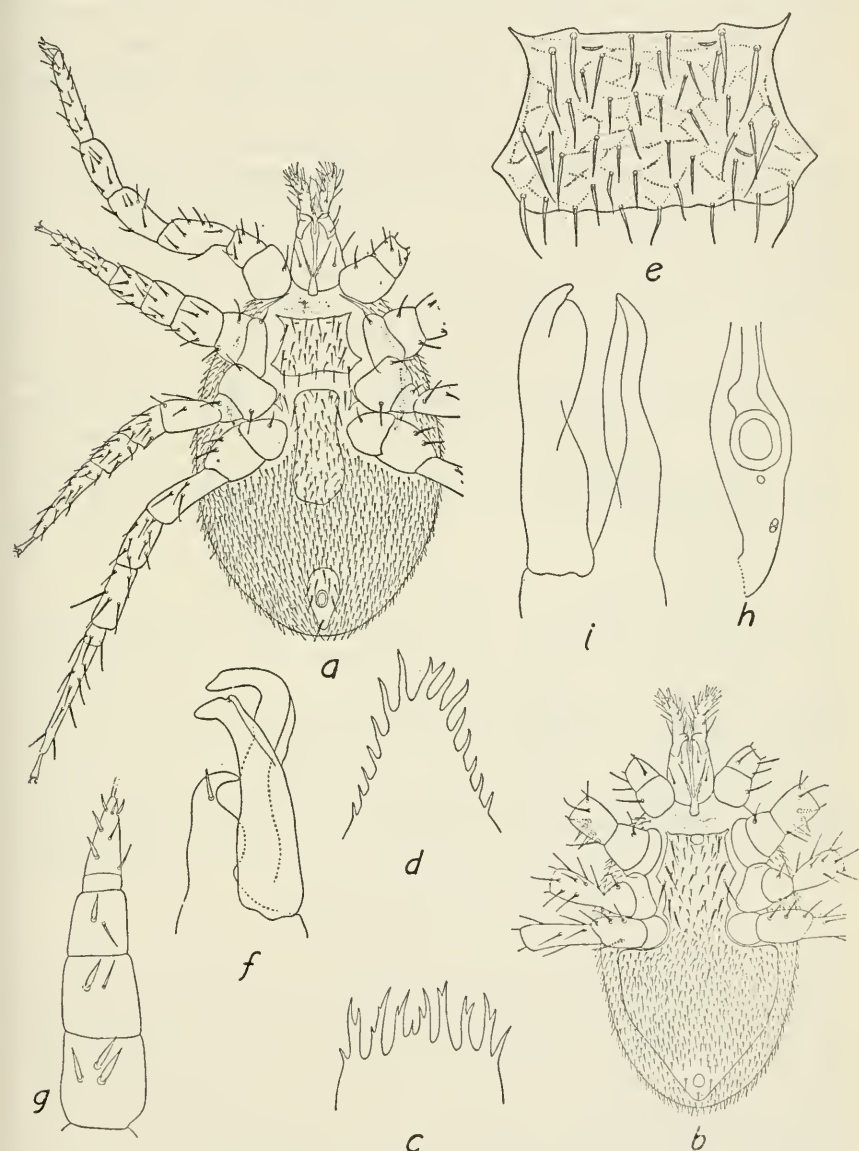


FIGURE 42.—*Haemogamasus hirsutus* Berlese: *a*, Ventral view of female; *b*, ventral view of male; *c*, epistome of female; *d*, epistome of male; *e*, sternal shield of female; *f*, chelicera of male; *g*, ventral view of leg II of male; *h*, posterior end of peritreme of female; *i*, chelicera of female.

near its midpoint. All setae on shield smooth. Anterior pair of sternal pores parallel with anterior margin of shield and at level of anterior pair of usual sternal setae. Genitoventral shield only slightly expanded posteriorly, with usual genitoventral setae and numerous smaller accessory setae (55 to 70 in number in available specimens); accessory setae distributed over entire shield; all genitoventral setae smooth. Anal shield narrow. Specimens examined had three usual anal setae and five smaller accessory setae; all anal setae smooth. Endopodal shields present as thin strands at level of junction of coxae III and IV. Metapodal shields small. Metasternal setae smooth and as large as usual sternal setae. Ventral body setae very numerous and slightly larger than dorsal setae, especially at posterior body margin, where two or three pairs are distinctively longer and stouter than the others. Peritreme slender, distinctive in shape, its posterior end in contact with fovea of coxa IV. Epistome with almost all fimbriae at its distal end; very few are lateral; most are branched. Chelae lack teeth; both possess bursae; fixed chela the stouter. All maxillary setae smooth. All palpal setae smooth; two especially strong ventral setae on tibia. Leg II shortest and stoutest; all legs with relatively large, strong, smooth setae, which are stouter and fewer ventrally. Length-width ratios of tarsi are: Leg I 5:1, leg II 4.5:1, leg III 6.5:1, leg IV 9:1.

*Male*.—Dorsal surface essentially as in female. Tritosternum and presternal area as in female. Accessory setae present over entire surface of ventral shield. The three usual pairs of sternal setae, as well as the metasternal and genitoventral setae, recognizable. The more anterior accessory setae larger, especially those lateral in position; as in the female two pairs of accessory setae present on the anterior margin of the shield. Setae of the posterior, expanded portion of the shield larger than those of the dorsal shield and, like them, of two types. Lateral margins of the shield not anteriorly directed lateral to coxae IV. All setae of ventral shield smooth. Peritremes as in female. Epistome sometimes with more lateral fimbriae than in female. Fixed chela toothless, with a pilus dentilis, and expanded medially. Movable chela bifurcate. Maxillae and palpi as in female. Leg II stouter than others and differing from that of female in the following distinctive setation: Femur with three stout ventral setae; genu with one stout and one medium ventral setae; tibia with one stout ventral seta; tarsus with two stout ventral setae. All setae smooth.

*Nymph*.—No nymphal specimens were available for study, but these according to Oudemans (1913), may be distinguished as those of *hirsutus* by similarity of epistome, chelicerae, and setation from those of the adult female. As in the adults, setae are reported to be smooth.

*Size*.—Four measurable females were 1,162 $\mu$ , 1,232 $\mu$ , 1,050 $\mu$ , and



952 $\mu$  in length. The single measurable male was 1,078 $\mu$  in length. Vitzthum (1931) gives the length of the male as 1,150 $\mu$  and reports that the length of the female varies from 1,100 $\mu$  to 1,380 $\mu$ .

*Remarks.*—Distinctive characteristics of *Haemogamasus hirsutus*, which make it possible to determine specimens of each sex from those of other species, are: FEMALE: All setae smooth; large and small setae interspersed on dorsal shield; two pairs of accessory setae on anterior margin of sternal shield; 24 to 32 accessory setae on sternal shield; anterior pair of sternal pores at level of anterior usual sternal setae. MALE: All setae smooth; accessory setae over entire ventral shield; two pairs of accessory setae on anterior margin of ventral shield; interspersed large and small setae on dorsal and ventral shields; specialized setation of leg II; femur with three stout ventral setae; genu with one stout and one medium ventral setae; tibia with one stout ventral seta; tarsus with two stout ventral setae; structure of chelae distinctive. NYMPH: Setation and mouth parts as in female.

Although Berlese (1889), Oudemans (1913), and Vitzthum (1931) describe *H. hirsutus* as possessing only three anal setae, the five female specimens available each possess the three usual anal setae plus five accessory setae. The condition of interspersed large and small setae on the dorsal shield of the female and on the dorsal and ventral shields of the male has not been previously reported.

*Distribution and hosts.*—This species has been reported by Berlese (1889), Oudemans (1913), and Vitzthum (1931) from "various insectivores" and "rodents" and their nests throughout Europe. I have examined three females from a "dead mole." Cornwall, England, collected in February 1943 (E. W. Jameson collection); one female from "mouse nest," Hell Coppice, near Oakley, Bucks, England, August 17, 1941 (E. W. Jameson collection); one male from *Talpa alpina*, Ratece, Slovenia, July 12, 1931; and one male and two females from "moles," Reskadinnick, Camborn, Cornwall, England, June 9, 1946.

#### HAEMOGAMASUS ALASKENSIS Ewing

##### FIGURE 43

*Haemogamasus alaskensis* EWING, Proc. Biol. Soc. Washington, vol. 38, pp. 138–139, 1925.—VITZTHUM, Zool. Jahrb. (Abt. Syst.), vol. 60, p. 397, 1931.

*Haemogamasus sternalis* EWING, Proc. U. S. Nat. Mus., vol. 82, art. 30, p. 3, pl. 1, fig. 2, 1933.

*Female.*—Dorsal shield entirely covering dorsal surface to coxae III, where there begins a thin crescent of unprotected integument as the shield narrows. Shield densely covered with small, slender, often barbed setae, most of which are between 10 $\mu$  and 20 $\mu$  apart and about 40 $\mu$  in length; pattern of setation broken at apex of shield, and setae in that region larger, farther apart, and more conspicuously barbed.

Especially prominent are the two usual apical setae, which are the largest setae on the shield and are heavily barbed; these are flanked by a pair of smaller, barbed setae, which are larger than most other

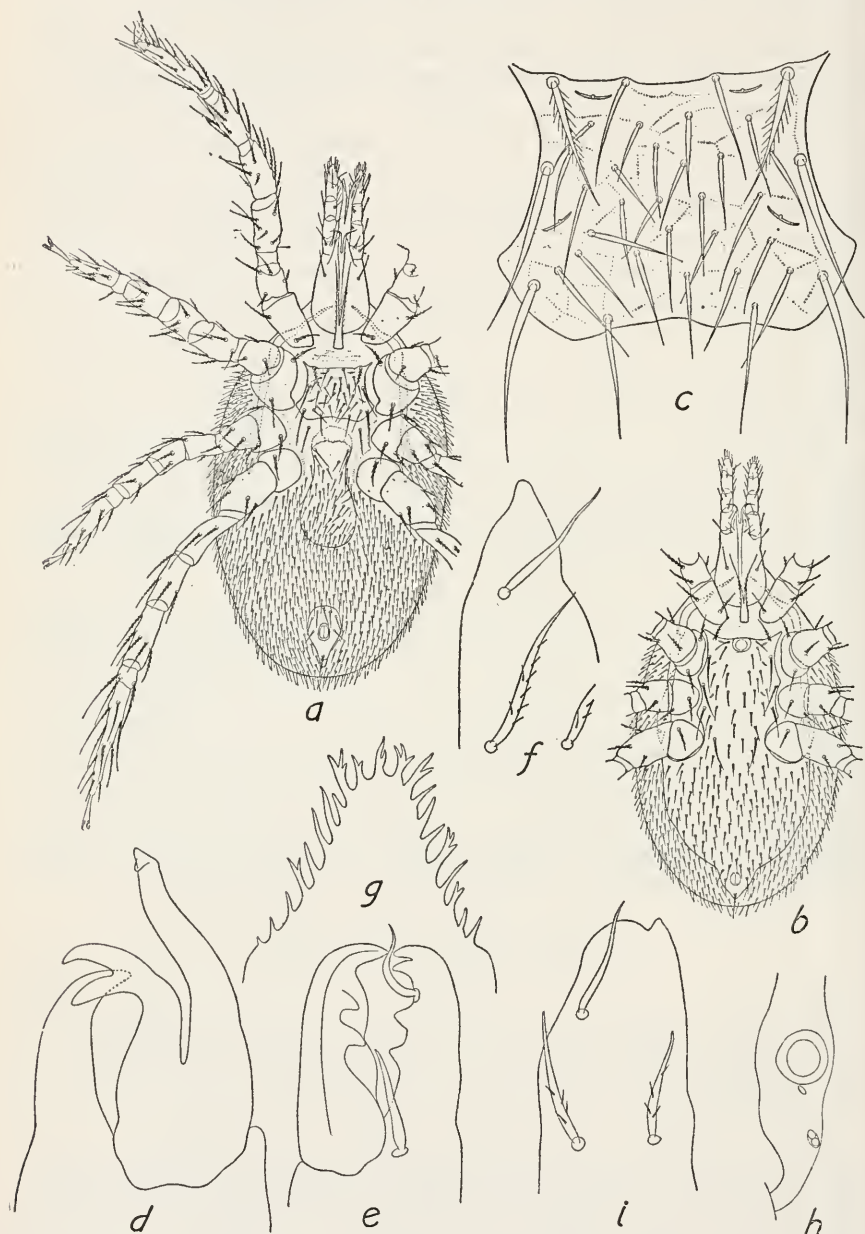


FIGURE 43.—*Haemogamasus alaskensis* Ewing: *a*, Ventral view of female; *b*, ventral view of male; *c*, sternal shield of female; *d*, chelicera of male; *e*, chelicera of female; *f*, cornicula of female; *g*, epistome of female; *h*, posterior end of peritreme of female; *i*, cornicula of male.

setae on the shield. Setae over most of the shield uniform in size but slightly larger at the margins, where they also are more often barbed. Entire shield sculptured, and two marginal pores present at the posterior end. Setae of the unprotected integument of the dorsal surface about twice as large as those on shield; larger and farther apart at the posterior margin. Tritosternum with both lacinae barbed. Presternal area sculptured with about five transverse sutures, each of which possesses minute posteriorly directed spines, which are larger on the more posterior sutures. Sternal shield rectangular, with all margins slightly concave, although variable in this respect; sculptured; with the six usual sternal setae and 10 to 32 smaller, accessory setae. In the series examined the mean number of accessory setae was 23. Accessory setae variable in size; those at the margins of the shield larger; in most specimens the anterior pair of usual setae are the only barbed setae on the shield; in a few specimens some of the larger accessory setae are barbed faintly. Distinctive is the fact that one pair of accessory setae is anterior to the others and on the anterior margin of the shield between the anterior pair of usual setae. This condition exists in all specimens examined. Two pairs of sternal pores on the shield; the more anterior of these nearly parallel with the anterior margin of the shield. Genitoventral shield moderately expanded posterior to coxae IV; sculptured; with the usual pair of genitoventral setae and 24 to 55 smaller, accessory setae; mean number of accessory setae was 42; both usual and accessory smooth in almost all cases; in some specimens a gap exists between the usual genitoventral setae and the more anterior accessory setae; in others with larger numbers of setae they may be present over the entire shield. Anus about equidistant from anterior and posterior margins of anal shield, which is roughly triangular, with a broadly rounded anterior margin and a sharply pointed posterior end; a narrow, pointed cribrum; shield lacks sculpturing and possesses the three usual anal setae and five or six smaller, accessory setae; in a series of 48 examined 13 had six accessory setae and 45 had five; posterior usual seta barbed and the largest seta on shield; it lies almost at the posterior end of the shield proper. Small metapodal shields present; these may vary somewhat in shape but are usually oval; some are nearly rectangular. Endopodal shields are thin strands closely applied to fovea of coxae III and IV. Ventral setae larger than those of dorsal surface, particularly at the margins of the body; these are larger and more heavily barbed near the body margins; those at the posterior margin largest. The pair of usual metasternal setae are smooth in almost all specimens and, with the usual sternal setae, are the largest setae of the ventral surface. Posterior ends of peritremalia fused to fovea of coxae IV; shape of expanded portion of peritreme containing stigma distinctive; tu-

bular portion of peritreme extends to level of midpoint of coxae II. Epistome narrow and pointed with 10 to 12 fimbriae on each lateral margin; some fimbriae simple, others branched doubly or triply. Chelae of about equal length; each nearly straight, bent sharply at tips. Fixed chela with a bifid tip and two teeth; a distal seta immediately posterior to the tip and a proximal seta at the base of the chela. Movable chela bent at nearly a right angle at its distal end and with two teeth. Maxillae distinctive in outline; all but anterior pair of maxillary setae barbed. Palpi only slightly tapering; coxa with an especially strong ventral, medially directed seta, which is barbed on one side; most setae on palpi barbed except those on tarsi; anterior margins of at least coxae, trochanter, and femur serrated. All setae of legs, except terminal tarsal setae, barbed; distal margins of all segments, except tarsi, serrated. Tarsal length-width ratios are: Leg I 5.5:1, leg II 4.5:1, leg III 6:1, leg IV 8:1.

*Male*.—Distinctly smaller and narrower than female. Dorsal shield covers almost entire dorsal surface. Setae on ventral shield correspond to those of female, including the single pair of accessory setae on its anterior margin. Usual genitoventral setae very little larger than accessory setae of genitoventral region; shield greatly expanded posterior to coxae IV and extending laterally and anteriorly to posterior ends of the peritremes; pores on shield correspond to those of the female in size and position. Metapodal and endopodal shields included in ventral shield. Peritreme and epistome as in female. Chelae greatly modified. Fixed chela toothless and without a seta. Movable chela much larger and divided near its proximal end into two branches, the dorsal of these in turn divided into two prongs distally. Maxillae as in female except that lateral horns are more blunt; as in the female, the anterior pair of maxillary setae are smooth. Palpi and legs as in female.

*Nymph*.—Body relatively shorter than in adults; a slitlike invagination on each side of dorsal shield at level of coxae IV; setation of dorsal shield as in adults except that setae may not be quite so numerous. Tritosternum and presternal area as in adults. Ventral shield extends to level of midpoint on coxae IV and bears four pairs of setae, representing the three pairs of usual sternal setae and the single pair of metasternal setae. The usual genitoventral setae flank the posterior end of the shield. As in adults, the anterior pair of usual sternal setae are barbed and are thicker than the others. Sternal pores located as in adults. Anal shield with only four setae: the three usual anal setae and the most anterior accessory seta; the posterior usual anal seta is the largest and is the only barbed seta on the shield. Ventral body setae as in adults. Peritreme not well chitinized. Epistome, mandibles, and maxillae as in female. Palpi as in adults but relatively stouter. Legs relatively stouter than in adults.



*Size*.—Thirty-two female specimens examined varied in length from  $900\mu$  to  $1,150\mu$  and in width from  $500\mu$  to  $600\mu$ ; mean length was  $1,001\mu$ ; mean width  $555\mu$ . Three male specimens measured  $775\mu$ ,  $775\mu$ , and  $700\mu$  in length and  $425\mu$ ,  $375\mu$  and  $375\mu$  in width. The two measurable nymphs were  $525\mu$  and  $800\mu$  in length and  $350\mu$  and  $500\mu$  in width. Ewing's type female measured  $1,120\mu$  in length and  $700\mu$  in width.

*Remarks*.—Distinctive features of *Haemogamasus alaskensis*, which serve to distinguish female, male, and nymph from those of other species are: FEMALE: Barbed setae on dorsal shield; single pair of accessory setae on anterior margin of sternal shield; number of sternal setae; number of genitoventral setae; shape of peritreme; shape of epistome, and possession of 10 to 12 multiply branched fimbriae on each lateral margin; fixed chela with a bifid tip and two teeth; movable chela with two teeth; shape of maxillae and smooth anterior maxillary setae; barbed setae on palpi and legs. MALE: Similarity to female in all except secondary sexual characters; single pair of accessory setae on anterior margin of ventral shield; shape of chela; lack of specialized setae on legs. NYMPH: General characteristics of female seen in setation and mouth parts.

Variation in this species is evident in body size, numbers of accessory setae on sternal, genitoventral, and anal shields, and to a slight degree in the shapes of these shields.

*Haemogamasus sternalis* Ewing, 1933, was described as differing from *alaskensis* only in having the sternal shield poorly sclerotized and festooned behind and in having the sternal setae arranged in irregular, transverse rows. The single female specimen upon which the description was based was taken by Francis Harper, August 12, 1925, from a short-tailed shrew, *Blarina brevicauda talpoides*, at Adirondack Lodge, Essex County, N. Y. Other than the type the only specimen identified as *H. sternalis* in the collection of the U. S. National Museum is a female taken from a pine mouse at Chevy Chase, Md. In view of the variation in shape of the sternal shield and in the number and arrangement of accessory setae on it in specimens of *H. alaskensis* taken from the same and closely related hosts and the same regions, it is my opinion that the two species are synonymous and that *H. alaskensis* Ewing, 1925, is the valid specific name.

*Distribution*.—*H. alaskensis* has been taken most frequently from the northeastern and northwestern United States and southern Canada. Records from such widely separated areas as Utah, Illinois, and North Carolina suggest that the more numerous northern records may be due, at least in part, to the presence of more active collectors in those regions.

*Records*.—I have examined material from: *Napaeozapus insignis insignis*, Mount Katahdin, Windy Pitch, Maine, August 27, 1928. *Myotis lucifugus lucifugus*, Mount Katahdin, Basin Ponds, Maine, September 7, 1928. *Microtus pennsylvanicus pennsylvanicus*, West Falmouth, Mass., June 8, 10, and 14, 1936; Edgartown, Mass., April 22, 1933; Squibnocket, Mass., June 11, 1936; Nantucket, Mass., June 13, 1936; Temagami, Ontario, June 28, 1934, and August 17, 1934; Erie County, N. Y., August 29, 1945. *Microtus montanus*, Oconalufy River, N. C., April 18, 1931. *Microtus oregoni*, Quillayute, Wash., May 7, 1930. *Microtus* sp., Uniat, Alaska, June 6 and 18, 1947. *Clethrionomys gapperi ochraceus*, Mount Katahdin, Chimney Bend, Maine, August 27, 1928; Mount Katahdin, Togue Ponds, Maine, August 26, 1928; Mount Katahdin, North Basin, Maine, September 1, 1928. *Clethrionomys gapperi*, Mount Watatic, Ashburnham, Mass., October 12, 1927. *Tamiasciurus hudsonicus* nest, Long Lake, N. Y., July 26, 1926. *Pitymys pinetorum*, Point Abino, Welland County, Ontario, September 4, 1945. *Lepus americanus*, Pancake Bay, Algoma, Ontario, July 12, 1932. *Clethrionomys gapperi*, Wayne County, Pa., July 9, 1945; Crawford County, Pa., September 12, 1945. *Peromyscus maniculatus gracilis*, Temagami, Ontario, September 8, 1934. *Blarina brevicauda talpoides*, Jay Peak, Vt., August 17, 1927; Morgan, Utah, August 31 and September 8, 1932; Ithaca, N. Y., August 30, 1936. *Blarina brevicauda*, Point Abino, Welland County, Ontario, August 28 and 30, and September 4, 7, 11, and 13, 1936. "Meadow Mouse," Nantucket, Mass., August 31, 1936. "Field Mouse," Lake County, Minn., April 22, 1931. Host not given, Takotna, Alaska, June 11, 1935; Urbana, Ill., October 18, 1937. "Pine Mouse," Chevy Chase, Md., June 7, 1932.

*Type*.—One female (U. S. N. M. No. 947) collected by A. H. Twitchell, July 23, 1924, on *Microtus* sp. at Crater Mountain, Ophir, Alaska.

#### HAEMOGAMASUS MANDSCHURICUS Vitzthum

##### FIGURE 44

*Haemogamasus mandschuricus* VITZTHUM, Zool. Jahrb. (Abt. Syst.), vol. 60, pp. 397-399, figs. 1-4, 1931.

*Female*.—Most dorsal setae barbed; usual pair of apical setae barbed and flanked by smaller setae, which are also barbed. Setae in apical region larger than those on remainder of shield. Setae on posterior portion of shield  $6\mu$  to  $20\mu$  apart and about  $45\mu$  in length. A pair of pores flank posterior end of shield. Setae of unprotected dorsal integument barbed and larger than those on shield, particularly at the posterior body margin where one or two pairs are distinctly larger than others of the region. Lacinae of tritosternum barbed. Presternal area distinctly sculptured with spines on all sutures. Sternal shield

with usual sternal setae and 14 smaller, accessory setae in the only specimen available for study. The anterior pair of usual sternal setae are the only barbed setae on the shield and are smaller than the other usual setae. Accessory setae on the posterior three-fourths of the shield. Anterior pair of sternal pores parallel with anterior margin

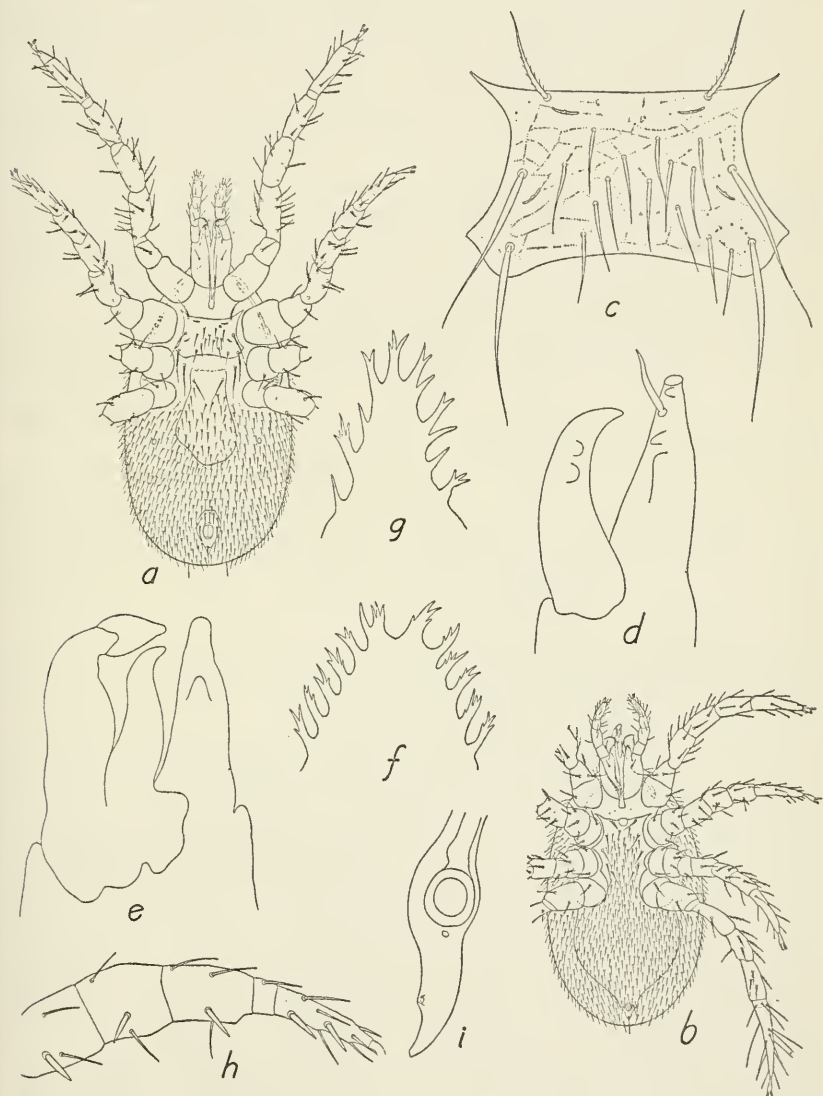


FIGURE 44.—*Haemogamasus mandschuricus* Vitzthum: *a*, Ventral view of female; *b*, ventral view of male; *c*, sternal shield of female; *d*, chelicera of female; *e*, chelicera of male; *f*, epistome of female; *g*, epistome of male; *h*, ventrolateral view of leg II of male; *i*, peritreme of female.

of shield. Genitoventral shield with 55 or 60 accessory setae in addition to the pair of larger usual genitoventral setae; accessory setae about twice as large as setae of dorsal shield; a definite gap between usual genitoventral setae and most anterior accessory setae; usual genitoventral setae and most of accessory setae smooth; some near posterolateral margin barbed. Anal shield with five accessory setae in addition to three larger usual anal setae. In the specimen studied there are two knoblike prominences on the anterior margin of the anal shield. Metasternal setae barbed. Ventral body setae adjacent to shield are of equal size with accessory genitoventral setae; laterally and posteriorly they are larger and more conspicuously barbed. Posterior end of peritreme relatively larger and slenderer than in other species; two lateral flaps present. Epistome pointed, with 8 to 10 multiply branched fimbriae on each lateral margin. Movable chela with two teeth. Fixed chela with a bifid tip and one tooth, which is followed by a ridge; a seta is present between the tooth and the tip of the chela. Long, narrow maxillary corniculi are distinctive; it cannot be determined on available specimen whether maxillary setae are barbed; most setae on palpi distinctly barbed. All setae of legs, except terminal setae of tarsi, barbed.

*Male*.—As in female setae on anterior portion of dorsal shield are larger than those posterior to level of coxae I; other aspects of setation of dorsal shields as in female. Dorsal body setae as in female. Tritosternum and presternal area as in female. Setation of ventral shield as in female including setation of sternal region; ventral shield curves laterally and anteriorly around coxae IV to contact posterior end of peritreme; posterior usual anal seta barbed, others not clear. Peritreme as in female. Integument between peritreme and coxae III and IV is sculptured and possesses spines as in the presternal area. Epistome narrow, with only four or five multiply branched fimbriae on each lateral margin. Movable chela divided into a short, stout sperm carrier and an apparently toothless branch. Fixed chela has only one tooth but may also possess a small distal seta. All maxillary setae barbed. Structure of maxillae not clear, but horns are distinctly wider than those of female. Palpi as in female. As in female almost all setae on legs are barbed. Leg II shows sexual dimorphism in that especially stout ventral setae are present on the following segments: Femur I, genu I, tibia I, tarsus II. Length-width ratios of tarsi are: Leg I 5.5:1, leg II 5.5:1, leg III 6:1, leg IV 9:1.

*Remarks*.—The nymphal stage has never been found. Distinctive features of each sex are: FEMALE: Most setae of dorsal shield barbed; accessory setae of sternal shield not present on anterior fourth of shield; 55 to 60 accessory setae on genitoventral shield; usual genitoventral shield smooth; 5 accessory setae on anal shield; knoblike



prominences on anterior margin of anal shield; posterior end of peritreme larger and slenderer than in other species; all fimbriae of epistome multiple; 8 to 10 fimbriae on each lateral margin; two teeth on movable chela; fixed chela with a bifid tip, a distal seta and one tooth; maxillary setae barbed; most palpal setae barbed; most setae on legs barbed. **MALE:** Setation as in female including pattern of setation of ventral shield, which curves laterally and anteriorly to contact posterior end of peritreme; peritreme as in female; blunt maxillary corniculi; spikelike epistome with four or five multiple fimbriae on each lateral margin; specialized, stout, ventral setae on femur, genu, tibia, and tarsus of leg II.

*Distribution and hosts.*—Vitzthum (1931) reported this species from *Phodopus bedfordiae* (Thomas) and *Dipus sowerbyi* Thomas, both from North China. The female specimen in the U. S. National Museum collection was taken from the mole *Scaptochirus gilliesi* at Wu-Ysai, Shansi, China. The male, which was obtained through the courtesy of Dr. Charles R. Remington, of Harvard University, was taken from *Clethrionomys amurensis mikado* in Japan. Specific locality data were not given.

*Size.*—Vitzthum gives the length of the female as  $1,060\mu$  to  $1,080\mu$ ; length of the male as  $770\mu$  to  $800\mu$ . The female specimen in the U. S. National Museum collection is somewhat distorted; the male measures  $770\mu$  in length and  $420\mu$  in width.

#### HAEMOGAMASUS LIBERIENSIS Hirst

FIGURE 55, a, b

*Haemogamasus liberiensis* HIRST, Journ. Zool. Res., vol. 1, pp. 76-78, figs. 10-11, 1916.—VITZTHUM, Zool. Jahrb. (Abt. Syst.), vol. 60, p. 400, 1931.

No specimens of this mite were available for study. The following data are taken from Hirst's (1916) original description.

*Female.*—Dorsal shield covers entire dorsal surface. Setae on shield short, barbed, and very numerous. Presternal area sculptured. Sternal shield with usual sternal setae and about 45 accessory setae, which are present over the entire shield and which are nearly as large as the usual setae; two pairs of accessory setae on anterior margin of shield; all of usual sternal setae, as well as many of accessory setae, barbed. Genitoventral shield not greatly expanded posteriorly, with numerous accessory setae present over entire surface of shield. It is impossible to determine from Hirst's figure whether usual genitoventral setae are larger than accessory setae; many setae on shield barbed. Anal shield with three usual anal setae and six or seven accessory setae in type specimen. Endopodal shields not figured or mentioned. Metapodal shields small and oval. Metasternal setae present. Ventral setae very numerous; nearly all are barbed. Structure of

peritreme not clear. Epistome not figured or mentioned. Nearly all setae on legs, except terminal setae on tarsi, are barbed. Distal margins of all leg segments, except tarsi, separated.

*Size*.—Length of body  $876\mu$ ; width  $560\mu$ .

*Distribution and hosts*.—The description was based on a single female specimen found on *Mus trivirgatus* at Gonyon, Liberia, by R. H. Bunting on November 20, 1910. Specimen in collection of H. C. Rothschild.

*Remarks*.—Distinguishing features of this mite are: Most setae on dorsal and ventral surface barbed; a large number of accessory sternal setae present over entire shield; two pairs of accessory setae on anterior margin of sternal shield; six or seven anal setae; fixed chela with bifid tip, two teeth, and a seta; movable chela with two teeth; most setae on legs barbed.

#### HAEMOGAMASUS AVISUGUS Vitzthum

*Haemogamasus avisugus* VITZTHUM, Zool. Jahrb. (Abt. Syst.), vol. 60, pp. 396–397, 1931.

No specimens of this mite were available for study. The following data are taken from Vitzthum's (1931) brief original description, which did not include figures.

*Female*.—Sternal shield with about 14 accessory setae. Usual sternal and metasternal setae not distinguished in length and thickness from accessory setae of sternal shield. Anterior pair of usual sternal setae strongly barbed; the others smooth. Genitoventral shield at its broadest part broader than the distance between coxae IV. Chelicerae of female with toothlike, sharply bent tips. Fixed chela with two teeth; movable chela with one tooth. Dorsal and ventral body setae smooth except along posterior body margin. Most setae on legs barbed.

*Male*.—Fixed chela of male normally formed with one tooth and a normal pilus dentilus. Proximal half of movable chela very thick; its distal half strongly bent, and deeply split, with a sperm carrier which reaches far beyond its end. Anterior margin of each coxa finely serrated.

*Remarks*.—Because of the unusually brief description and lack of figures it is difficult to determine the relationship of this mite to others in the genus. However, the fact that the sternal shield of the female possesses only about 14 accessory setae and that these are as large as the usual setae is distinctive. No other member of the genus possesses only one tooth on the movable chela. Vitzthum's description of the chelae of the male most closely fits *H. mandschuricus*.

*Size*.—Length of female  $925\mu$  to  $960\mu$ ; length of male  $775\mu$  to  $800\mu$ .

*Distribution and host*.—On *Riparia riparia* in Germany.

## HAEMOGAMASUS HARPERI, new species

FIGURE 45

*Female*.—Dorsal shield sculptured; bluntly pointed at both ends; relatively narrow; a distinct strip of unprotected integument between the shield and lateral and posterior margins of body; shield widest at level of coxae II. Usual pair of apical setae about equal in size to several of the more anterior setae of apical region and flanked by a pair of much smaller setae. Over the entire shield, posterior to apical region, setae are between  $20\mu$  and  $40\mu$  apart and at least  $80\mu$  in length; those nearest apical region are slightly larger; all setae smooth. Setae of unprotected dorsal integument of equal size with those on shield at corresponding levels; are generally largest on anterior portion of body, although some at posterior body margin may be longer and slenderer; all are smooth. Lacinae of tritosternum barbed. Pre-sternal area well chitinized and sculptured; distinctly concave posterior to base of tritosternum; no spines present. Sternal shield with three pairs of usual sternal setae and several smaller accessory setae, which varied in number from four to seven in 22 specimens examined; the mean number was six; these appear to be arranged in pairs in most specimens; none are on the anterior margin of the shield. Usual setae stout; anterior pair slightly smaller than the others and on anterior margin of shield distinctly mediad to middle pair; bases of all usual setae embossed or elevated from the surface of the shield. Anterior pair of sternal pores nearly parallel with anterior margin of shield; all setae smooth. Genitoventral shield narrow, sculptured, and in most specimens not wider than distance between coxae IV; posterior margin of shield may be nearly straight or even slightly concave. Usual genitoventral setae smaller than usual sternal and metasternal setae. Accessory setae smaller than usual setae and almost entirely in posterior half of shield, smallest at posterior margin; about as large as accessory setae of sternal shield; number varying from 11 to 18 in 18 specimens examined; mean number 14; all setae smooth. Anal shield comparatively narrow; over twice as long as wide; anus almost entirely in posterior half of shield; with three usual anal setae and seven larger accessory setae. In some specimens the posterior usual anal seta may be as large as the smaller accessory setae; all setae smooth. Small endopodal and metapodal shields present. In some specimens there are four or five small, rounded shields lateral to the genitoventral shield; these appear to be in the integument rather than on its surface. Tubular portion of peritreme extends to anterior margin of coxae III; posterior margin of peritreme fused with fovea of coxa IV. Metasternal setae slightly slenderer than but equally as long as usual sternal setae. Ventral body setae smaller but not so far apart as those of dorsal shield; all are smooth. Epistome with

7 to 10 fimbriae on each side; most lateral fimbriae simple; distal fimbriae branched. Both chelae toothless. Fixed chela slenderer. Movable chela grooved and twisted on its longitudinal axis; no setae

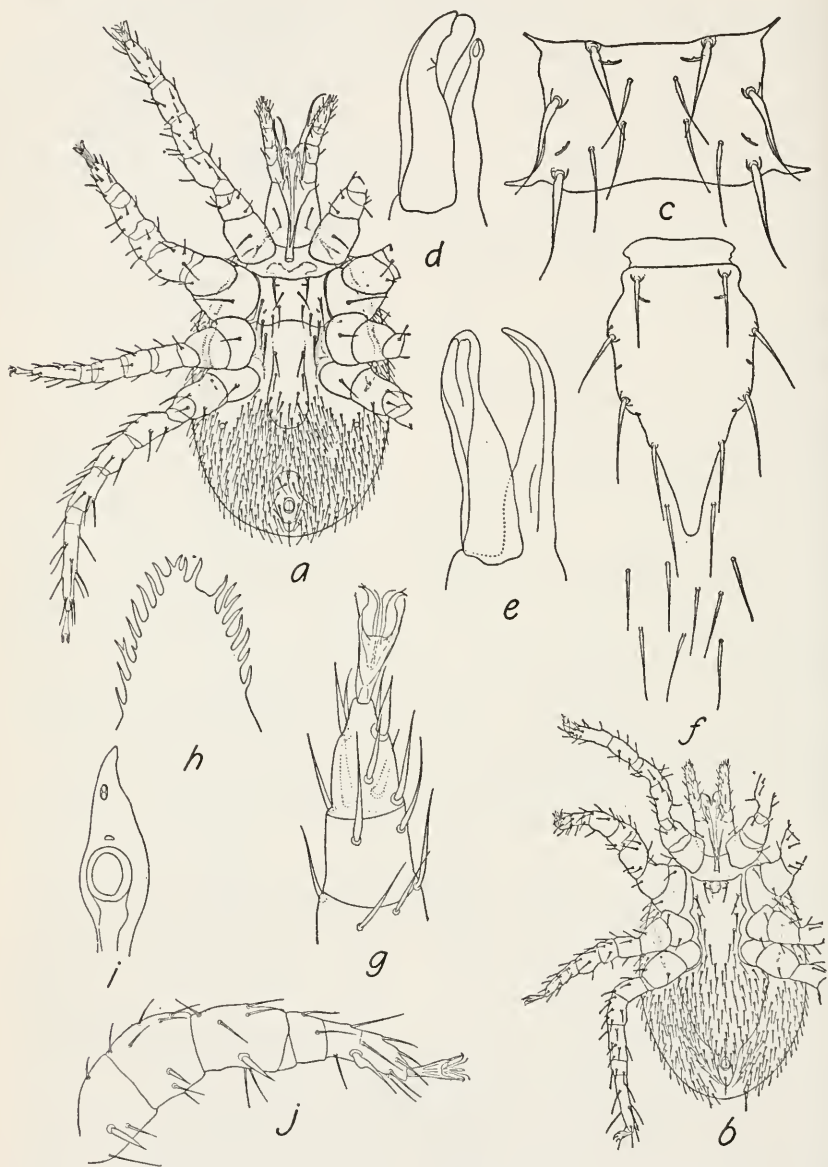


FIGURE 45.—*Haemogamasus harperi*, new species: *a*, Ventral view of female; *b*, ventral view of male; *c*, sternal shield of female; *d*, chelicera of male; *e*, chelicera of female; *f*, ventral shield of nymph; *g*, tarsus of leg II of female; *h*, epistome of female; *i*, posterior end of peritreme of female; *j*, ventrolateral view of leg II of male.



present. Structure of maxillae not clear; maxillary setae smooth. All palpal setae smooth. Legs stout; legs I and IV longest; leg II shorter and comparatively thicker than others; coxa of leg II much larger than those of other legs. Tarsi of all legs relatively shorter than those of most other species and also distinct in being abruptly narrow distally. Length-width ratios of tarsi are: Leg I 4:1, leg II 3.5:1, leg III 4.5:1, leg IV 5:1. Stout setae are present on distal ends of tarsi II, III, and IV; all setae smooth; as in other species, ventral setae are stouter.

*Male*.—Dorsal shield and its setation, as well as setation of unprotected dorsal integument, as in female. Tritosternum and presternal area as in female. Ventral shield relatively narrow, not covering entire ventral surface posterior to coxae IV and not curving anteriorly lateral to coxae IV. Usual sternal, metasternal, and genitoventral setae present as well as accessory setae of genitoventral region; accessory sternal setae lacking; usual sternal setae as in female; middle pair of usual sternal setae on lateral margin of shield; anterior pair of sternal pores angled posteriorly. A distinct gap between most anterior accessory setae of genitoventral region and usual genitoventral setae. Long, narrow anal region distinctive; setation of this region as on anal shield of female. Endopodal shields fused with ventral shield. Metopodal shields as in female, a distinctive feature. Ventral body setae, peritreme, and epistome as in female. Fixed chela shorter and stouter than in female and with a spatulate tip. Movable chela with an abruptly truncated tip and with a small tooth near its distal end, the bursa larger distally. Legs no thicker than those of female. Leg II differs from that of female in having a strong ventral seta on each of the following segments: femur, genu, tibia, and tarsus; tarsal seta is distinctive in that its thick proximal portion abruptly narrows into a slender distal spike. Tarsus II lacks the short, stout, distal setae of the female and may be relatively shorter than the latter, although this is not the case in all specimens.

*Nymph*.—Relatively shorter than adults. On one uncrushed specimen the dorsal shield covers the entire dorsal surface. Dorsal setation, tritosternum, and presternal area as in adults. Ventral shield with usual sternal and metasternal setae; usual genitoventral setae flank the narrow posterior end of shield; middle and posterior pairs of usual sternal setae as well as metasternal setae are on lateral margins of shield. Setae are as in adults except that middle and posterior pairs of sternal setae are relatively closer than in the former. The tapering, narrow posterior end of the shield is distinctive. Sternal pores as in female; posterior pair touch the lateral margins of the shield. Anal shield may be relatively shorter than in female; with

three usual anal setae and three larger most anterior accessory setae. Ventral body setae not so numerous as in adults. Peritreme weakly chitinized, differing from adults in that tubular portion extends to level of midpoint of coxae II; lateral flaps present. Epistome as in adults. Chelicerae as in female but relatively shorter. Maxillae not clear. Setation of palpi as in adults. Legs as in adult female but may be relatively shorter.

*Remarks.*—Distinctive features of *H. harperi*, which make it possible to distinguish female, male, and nymph from those of other species are: FEMALE: All setae smooth; relatively narrow dorsal shield; small number of accessory setae on sternal shield, four to seven in specimens examined; stout usual sternal setae with embossed bases; narrow genitoventral shield with relatively small number of setae, 11 to 18 in available specimens; anal shield relatively narrow; over twice as long as it is wide; with seven accessory setae which are larger than usual anal setae; anus almost entirely in posterior half of shield; both chelae toothless; relatively short tarsi which narrow abruptly distally; short, stout setae on distal ends of tarsi. MALE: Setation as in female; narrow ventral shield, which does not cover entire ventral surface or curve anteriorly lateral to coxae IV; second pair of usual sternal setae on lateral margins of shield; accessory sternal setae absent; long, narrow anal region; femur, genu, tibia, and tarsus of leg II each with a conspicuously strong ventral seta; that of tarsus II about midway between anterior and posterior ends of tarsus. NYMPH: Setation as in adults; ventral shield more gradually tapered posteriorly than in other species; anal shield with six setae; accessory setae larger than usual setae; mouth parts as in female; short, abruptly tapering tarsi as in adults.

*Size.*—Seven measurable females varied in length from  $1,075\mu$  to  $1,300\mu$ ; mean length was  $1,129\mu$ ; it was impossible to obtain accurate measurements of width. Eighteen measurable males varied in length from  $925\mu$  to  $1,025\mu$ ; width of the same series varied from  $55\mu$  to  $600\mu$ ; mean length was  $968\mu$ ; mean width  $555\mu$ . Length of measurable nymphs was  $975\mu$  and  $800\mu$ ; width of the latter specimen was  $475\mu$ .

*Distribution.*—Specimens have been taken only in Florida, Georgia, Mississippi, and South Carolina. I have examined specimens from: *Scalopus aquaticus howelli*, Handsboro, Miss., date?; Decatur County, Ga., January, March 11, April 2, 1947; Brooks County, Ga., October 2, 1947. *Scalopus aquaticus australis*, Folkston, Ga., January 10, 1936, Welaka, Fla., May 27, 1947. *Cryptotis parva*, Thomasville, Ga., Jan. 13, 1937. "Mole," Charleston, S. C., July 1930; Decatur County, Ga., January 1947, April 2, 24, 27, 1947, May 6, 1947, July 24, 1947; State College, Miss., October 31, 1937.



## EUHAEMOGAMASUS AMBULANS (Thorell)

FIGURES 41, 46

- Dermanyssus ambulans* THORELL, Öfv. Vet.-Akad. Forh., vol. 2, p. 164, 1872.
- Gamasus ovalis* KOCH, Kongl. Svenska Vet.-Akad. Handl., vol. 16, No. 5, pp. 121-122, table 5, figs. 3-3a, 1878.
- Haemogamasus nidi* MICHAEL, Trans. Linn. Soc. London, vol. 5, pp. 314-315, pl. 32, figs. 6, 7, 1892.—HIRST, Bull. Ent. Res., vol. 5, pp. 121-122, 1914.—VITZTHUM, Zool. Jahrb. (Abt. Syst.), vol. 60, p. 401, 1931.
- Laelaps ovalis* (Koch) TRÄGÅRDH, Zool. Anz., vol. 25, p. 61, 1902.
- Haemogamasus michaeli* OUDEMANS, Tijdschr. Nederl. Dierkund. Ver., ser. 2, vol. 8, pp. 87-88, 1903; Arch. Naturg., vol. 79, Abt. A, Heft 8, pp. 155-160, figs. 108-140, 1913.
- Hypoaspis ambulans* (Thorell) TRÄGÅRDH, Fauna Arctica, vol. 4, Lief. 1, p. 33, figs. 55-58, 1904.
- Eulaelaps ambulans* (Thorell) TRÄGÅRDH, Nat. Unter. Sarekgebirges Swed. Lap., vol. 4, Lief. 4, pp. 435-437, figs. 116-122, 1910.
- Haemogamasus reidi* EWING, Proc. Biol. Soc. Washington, vol. 38, p. 140, 1925.
- Haemogamasus twitchelli* EWING, Proc. Biol. Soc. Washington, vol. 38, pp. 142-143, 1925.—VITZTHUM, Zool. Jahrb. (Abt. Syst.), vol. 60, p. 401, 1931.
- Euhaemogamasus onychomydis* EWING, Proc. U. S. Nat. Mus., vol. 82, art. 30, p. 4, pl. 1, fig. 3, 1933.
- Euhaemogamasus sciuropteri* KEEGAN, Trans. Amer. Micr. Soc., vol. 65, No. 1, p. 72, figs. 8-9, 1946.

*Female*.—Described from European specimens. Dorsal shield does not entirely cover dorsal surface; widest at level of coxae III. Usual pair of apical setae clearly largest on shield. Setae sparser in apical region but over remainder of shield between  $9\mu$  and  $12\mu$  apart laterally and  $9\mu$  to  $20\mu$  apart anteroposteriorly. They average about  $35\mu$  in length but may be larger in apical region and at posterior margin. Usual pair of apical setae and many of the other setae on shield barbed. Five pairs of pores on shield. Dorsal body setae larger and not so closely set as setae on shield, nearly all barbed, larger at posterior body margin. On one specimen a terminal pair is larger, but not so stout, as usual apical setae. Lacinae and base of tritosternum barbed. Presternal area sculptured; sutures with spines. Sternal shield about one a half times as wide as long; posterior margin of shield slightly invaginated. Only anterior pair of sternal setae barbed. Anterior pair of sternal pores nearly parallel with anterior margin of shield. Genitoventral shield flask-shaped, varying somewhat in size and outline. Accessory setae numbered 70-85 in all European specimens examined; usual pair of genitoventral setae anterior to all accessory setae and larger than the latter; more anterior accessory setae larger. All setae on shield smooth. Length-width ratio of anal shield about 1.5:1. Usual anal setae and five smaller accessory setae present on all specimens examined. Posterior unpaired usual setae largest on shield, sometimes with a few barbs. Setae smaller than adjacent ventral body setae. Endopodal shields slender. Metapodal



shields rodlike. Metasternal setae smooth, about as large as usual sternal setae. Ventral body setae not so closely set as setae of dorsal

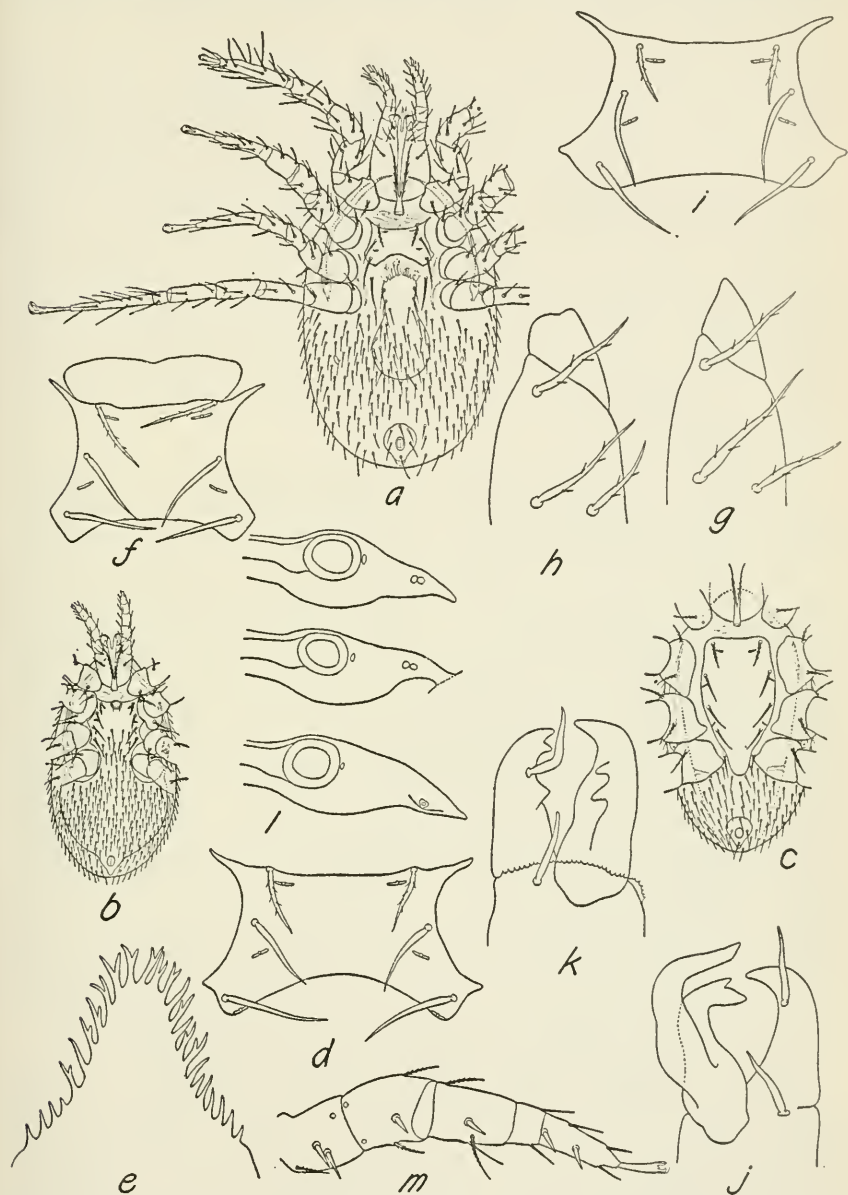


FIGURE 46.—*Euhaemogamasus ambulans* (Thorell): a, Ventral view of female; b, ventral view of male; c, ventral view of nymph; d, sternal shield of female from North America; e, epistome of female; f, sternal shield of female from England; g, cornicula of female; h, cornicula of male; i, sternal shield of female from Japan; j, chelicera of male; k, chelicera of female; l, peritreme of three female specimens; m, ventrolateral view of leg II of male.

shield and larger than the latter; nearly all are barbed; largest on posterior body margin. Peritreme with lateral expansions at level of coxae II–III and I–II; shape of posterior end distinctive; tubular portion extends to level of anterior margin of coxae II. Epistome relatively narrow, spikelike, with about 12 fimbriae on each lateral margin; several fimbriae multiple. Chelae about equal in length: movable chela may be slightly larger. Fixed chela with a bifid tip and one tooth; an inflated seta immediately posterior to the tip; a basal setae also present in most specimens. Movable chela with a pointed tip and two teeth; a faint, fringed bursa at its base. All maxillary setae barbed. Corniculi narrow, pointed. Barbed setae present on all palpal segments except tarsus; stout ventral setae on coxae barbed. Most setae on all leg segments barbed; setae of legs relatively long; longer and slenderer on dorsal surfaces of all segments. Length-width ratios of tarsi are: Leg I 7:1, leg II 5:1, leg III 6:1, leg IV 8:1.

*Male*.—Described from North American specimens. Dorsal shield covers almost entire dorsal surface; setation and pores as in female. Dorsal body setae, tritosternum, and presternal area as in female. Ventral shield widely expanded posterior to coxae IV, curving anteriorly lateral to coxae to contact lateral margin of posterior end of peritreme; anal region distinct. In most specimens accessory setae are present as far anterior as level between posterior pair of sternal setae and metasternal setae. Only anterior pair of sternal setae are barbed. Pores as in female. Accessory setae larger and not so numerous as those of dorsal shield; much more numerous in some specimens than in others. Accessory setae of anal region varied in number from three to five; in one specimen accessory setae were all posterior to coxae IV. Peritreme as in female; tubular portion may vary in length considerably. Epistome as in female. Chelae show marked sexual dimorphism. Fixed chela toothless; with distal and proximal setae as in female. Movable chela divided about midway on its length; shorter branch with a bifurcate tip. Maxillae and palpi as in female except for sexual dimorphism shown on leg II, where stout ventral setae are located as follows: femur two, genu one, tibia one, tarsus two.

*Nymph*.—Described from North American specimens. Dorsal shield much narrower than in adults; setae not so numerous as in adults; most are smooth; dorsal pores not visible; a slitlike invagination on each lateral margin of shield at level of coxae IV. Tritosternum and presternal area as in adults. Ventral shield with sternal and metasternal setae; pores located as in adults. Anal shield with three usual anal setae and one smaller accessory seta in most specimens; a few possess another accessory seta near anterior margin of shield. Peritreme not well developed. Epistome, chelae, maxillae, and

palpi as in adults. Legs as in adult female; may be relatively shorter.

*Size*.—Michael (1892) gave the length of the female as  $940\mu$ , width  $510\mu$ ; length of male  $720\mu$ , width  $400\mu$ . Oudemans (1913) gave the following measurements for the species: Female: length  $1,000\mu$ , width  $600\mu$ ; male: length  $850\mu$ , width  $460\mu$ ; nymph: length  $735\mu$ , width  $405\mu$ . Seven female specimens from Europe varied from  $882\mu$  to  $1,036\mu$  in body length and  $490\mu$  to  $588\mu$  in body width. Mean length was  $952\mu$ , mean width  $558\mu$ . In a series of 66 females from North America body length varied from  $700\mu$  to  $1,078\mu$ ; mean was  $871\mu$ . Forty-nine females varied in width from  $420\mu$  to  $672\mu$ ; mean was  $515\mu$ . Eight male specimens varied in length from  $658\mu$  to  $882\mu$ ; mean was  $773\mu$ . Six males varied in width from  $327\mu$  to  $560\mu$ ; mean was  $425\mu$ . Five nymphs varied in length from  $518\mu$  to  $728\mu$ , and in width from  $336\mu$  to  $448\mu$ ; mean length was  $605\mu$ ; mean width was  $400\mu$ .

*Discussion*.—Several factors contributed to the lengthy synonymy of this species. The original descriptions of Thorell (1872) and Koch (1878) are so indefinite that it is impossible to determine from them even the genus to which the described species belongs. Accordingly, when Michael (1892) published his description of *Haemogamasus nidi* this was accepted as the original description of the species. It was not until this manuscript was near completion that Dr. E. W. Baker, of the U. S. Bureau of Entomology and Plant Quarantine, forwarded to me a photostat of Trägårdh's 1910 paper with the comment that the species described and figured as *Eulaelaps ambulans* (Thorell, 1872) appeared to be a member of the Haemogamasinae. The figures and description left no doubt that the species was synonymous with Michael's *nidi*. The earlier references of Thorell (1872), Koch (1878), and Trägårdh (1902 and 1904) were then examined, and it was discovered that Trägårdh had studied the specimens described as *Dermanyssus ambulans* by Thorell and as *Gamasus ovalis* by Koch and had found them to be synonymous. He transferred the species from the genus *Laelaps* to *Hypoaspis* in 1904 and to *Eulaelaps* in 1910.

Distinctive features of female specimens of *E. ambulans* taken in Europe may be summarized as follows: Dorsal shield not entirely covering dorsal surface; many dorsal setae barbed; usual apical setae clearly largest on shield. Dorsal body setae barbed. Tritosternum barbed; presternal area with spines. Sternal shield rectangular; only anterior pair of sternal setae barbed; anterior pair of sternal pores nearly parallel with anterior margin of shield. Genitoventral shield flask-shaped; 75–80 accessory setae, all of which are posterior to usual genitoventral setae. Five accessory setae on anal shield. Epistome relatively narrow, with about 12 fimbriae on each lateral margin. Fixed chela with a bifid tip, one tooth, and a distal and a proximal seta. Movable chela with two teeth and a basal fringe of tiny setae. Maxillary setae barbed. Most setae on legs barbed.

Also possessing most of these characteristics in common are type specimens of the following North American species: *Haemogamasus reidi* Ewing, 1925; *H. twitchelli* Ewing, 1925; *Euhaemogamasus onychomydis* Ewing, 1933; *E. oregonensis* Ewing, 1933, and *E. sciuropteri* Keegan, 1946. These differ from one another almost entirely in numbers of setae on dorsal, genitoventral, and anal shields and in numbers of dorsal and ventral body setae. When these species were described it was assumed that, as in species of several other subfamilies of Laelaptidae, numbers of genitoventral and anal setae were specifically constant and were useful taxonomic aids. Accordingly, Ewing described *H. twitchelli* as possessing eight anal setae and *H. reidi* as possessing only three. One of the diagnostic features of genus *Euhaemogamasus* Ewing, 1933, was possession of three anal setae. *E. oregonensis* was further characterized as having about 20 genitoventral setae. *E. sciuropteri* was to be separated from other species of the genus by possession of five anal setae and 28–30 genitoventral setae.

First indication of variation in numbers of both genitoventral and anal setae was discovered upon examination of the type specimens of each species. Five of the seven female specimens on the type slide of *H. reidi* possessed 24, 30, 18, 22, and 25 genitoventral setae; six of the seven specimens had 3, 3, 4, 4, 5, and 6 anal setae. The type female of *H. twitchelli* had about 50 genitoventral setae and eight anal setae. The type female of *E. onychomydis* had about 50 genitoventral setae and at least six anal setae. Each of two females on the type slide of *E. oregonensis* had about 45 genitoventral setae and eight and seven anal setae. Hirst (1914) reported that numbers of anal setae of European specimens of *ambulans* varied from seven to nine.

Specimens in the U. S. National Museum collection previously identified as *H. twitchelli*, *H. reidi*, *E. onychomydis*, and *E. oregonensis* include the types of each species and a total of 150 specimens taken from a variety of hosts and habitats from several of the eastern, central, and western United States and southern Canada. The type female of *E. sciuropteri* was deposited in the collection of the Army Medical Museum. Upon examination of this series it was found that, like the types, all possessed the most distinctive characteristics of *E. ambulans*, differing from it, and among themselves, in the following characteristics: Numbers of setae on dorsal, genitoventral, and anal shields and on dorsal and ventral body surfaces; length-width ratio of sternal shield; relative size of genitoventral shield; slight differences in structure of posterior end of peritreme; presence of basal seta on fixed chela. These characteristics were found to vary to the following extent:

SETATION OF DORSAL SHIELD AND DORSAL AND VENTRAL BODY SURFACES:  
It is difficult to express the relative thickness or sparseness of setation



of these surfaces except by indicating distances of setae from one another. This was found to vary from as little as  $4\mu$  to  $15\mu$  to as much as  $30\mu$  to  $60\mu$ . More numerous setae on the dorsal shield and dorsal and ventral body surfaces were usually associated with larger numbers of setae on genitoventral and anal shields. In general, setae of these surfaces were more numerous on western specimens.

**NUMBERS OF GENITOVENTRAL SETAE:** Varied from 12 to 70 in a series of 104 specimens examined; the mean was 31. Larger numbers were usually found on western specimens. Of 39 specimens with more than 30 genitoventral setae, all but five were taken in western States. However, third from the top of the list with 60 setae is a specimen from New Hampshire. Of the 65 specimens with less than 31 setae, only seven were taken in western States.

**NUMBERS OF ANAL SETAE:** In a series of 88 specimens numbers of anal setae varied from 3 to 8; the mean was 5.6. Although larger numbers were usually associated with more numerous genitoventral setae, this was not always the case. Examples of such disparity are shown in the following combinations: 20 genitoventral setae with 7 anal setae; 29 genitoventral setae with 7 anal setae; 55 genitoventral setae with 5 anal setae; 45 genitoventral setae with 6 anal setae. Larger numbers were found most often on western specimens.

**LENGTH-WIDTH RATIO OF STERNAL SHIELD:** In seven European specimens of *E. ambulans* the length-width ratio of the sternal shield varied from 1.2:1 to 1.7:1. In 76 North American specimens this ratio varied from 1.3:1 to 2.4:1. In general, lower ratios were associated with larger numbers of setae. This ratio in most cases represents a variation in the margin separating the presternal area and the sternal shield proper rather than in position of pores and setae. In specimens with higher ratios the anterior pair of sternal setae is on the anterior margin of the shield rather than slightly posterior to it.

In addition to variations previously discussed, North American specimens show slight variations in details of structure of the posterior end of the peritreme and in presence or absence of a basal seta on the fixed chela.

An attempt to separate specimens of this series into distinct species on the basis of possession three, five, or eight anal setae would necessitate separation of specimens from single lots or from identical hosts and localities into several species. It is my opinion that, since the concept of constant seta number upon which *H. reidi*, *H. twitchelli*, *E. onychomydis*, *E. oregonensis*, and *E. sciuropteri* were described has been demonstrated to be erroneous, these species are one and, lacking further means of distinction, should be considered synonymous with *E. ambulans*.

**Distribution.**—Reported from Greenland by Thorell (1872); Siberia by Koch (1878); Great Britain by Michael (1892), Hirst (1914), and

Turk (1945); Holland by Oudemans (1913); Germany by Hirst (1914); and middle and western Europe by Vitzthum (1931) from birds and from a variety of small mammals but most often from rodents. I have examined specimens from: *Apodemus sylvaticus*, Torrington, Devon, England, March 18 and 22, 1937; Reskadinnick, Camborn, Cornwall, England, March 17, 1946 (E. W. Jameson collection). *Apodemus flavicollis*, North Sarajevo, Bosnien, July 12, 1929. *Sciurus niger rufiventer*, Allegan County, Mich., October 19 and December 26, 1937, February 10, 1938. *Sciurus griseus nigripes*, San Simeon, Calif., May 28, 1931; Santa Lucia Mountains, Calif., date?. *Sciurus carolinensis*, Point Abino, Welland County, Ontario, September 13, 1945. *Neotoma fuscipes macrotis*, San Simeon, Calif., May 29, 1931. *Neotoma fuscipes*, Monterey, Calif., February 14, March 16, 1946. *Neotoma cinerea*, Logan Canyon, Utah, July 13, 1933. *Neotoma* sp., Monterey, Calif., May 27, 28, 1945, July 16, 1938. *Microtus agrestis*, locality? date?. *Glaucomyss volans volans*, East Falls Church, Va., February 27, 1934, Seymour, Ill., November 9, 1937. *Glaucomyss volans*, Welland County, Ontario, September 1, 1946. *Glaucomyss sabrinus macrotis*, Saxtons River, Vt., December 24, 1934, Wayne County, Pa., July 17, 1945. *Glaucomyss* sp., MacDonald College, Quebec, November 3, 1940. *Microtus operarius operarius*, Takotna, Alaska, December 1934. *Microtus californicus*, Monterey, Calif., August 21, 1940, December 5, 1938, April 14, 1945. *Microtus* sp., Takotna, Alaska, June 1, 1934, Monterey, Calif., November 15, 1948. *Clethrionomys gapperi ochraceus*, Mount Washington, N. H., July 1, 1928. *Thomomys fuscus*, Colfax, Wash., April 14, 1927. *Thomomys talpoides*, Garland, Colo., July 1940; *Thomomys* sp., Fresno, Calif., July 6, 1932. *Tamiasciurus hudsonicus*, Ithaca, N. Y., March 4, 1939. *Blarina brevicauda*, Point Abino, Welland County, Ontario, September 1, 1946. *Thomomys monticola*, Huntington Lake, Fresno County, Calif., January 27, 1948. *Clethrionomys amurensis mikado*, Sapporo Hokkaido, Japan, November 27, 1945. *Sorex palustris*, Montana, October 17, 1947 (U.S.P.H.S. collection, Hamilton, Mont.). "Alaska short-tailed mouse," Golovin, Alaska, May 19, 1931. "Short-tailed mouse," Golovin, Alaska, May 9, 1931. "Red-shouldered hawk," Halifax, N. C., October 26, 1935. "Blue jay," Ontario, May 16, 1917. "Red squirrel," Ontario, May 11, 1907. "Chipmunk," San Simeon, Calif., June 9, 1931; "Government Camp," Oregon, May 19, 1934. "Pine marten," Big Pines, Santa Lucia, Calif., May 23, 1931. "Gray squirrel," San Simeon, Calif., June 9, 1931, Good Hope Township, Ohio, June 6, 1937; Idyllwild, Riverside County, Calif., December 9, 1948 (Bureau of Vector Control collection, Dept. Public Health, Calif.). "Gray squirrel nest," Patuxent Game Reserve, Bowie, Md., May 22, 1943. "Flying squirrel," Clemson, S. C., December 14, 1940;

Kenwood, Ontario, November 22, 1921. "Townsend mole," Clackamas County, Oreg., May 30, 1932. "In squirrel hole," Urbana, Ill., March 31, 1944. "Raccoon," Bowie, Md., November 2, 1943. "Cottontail rabbit," Allegan, Mich., April 1, 1937. "Bobwhite," Halifax, N. C., January 17, 1933. "In chicken nest," Astoria, Oreg., September 8, 1937.

**EUHAEMOGAMASUS HORRIDUS (Michael)**

**FIGURE 47**

*Haemogamasus horridus* MICHAEL, Trans. Linn. Soc. London, vol. 5, pp. 312-313, pl. 32, figs. 1-5, 1892.—OUDEMANS, Arch. Naturg., vol. 79, Abt. A, Heft 8, pp. 146-155, figs. 98-107, table 11, figs. 11-15, 1913.—HIRST, Journ. Zool. Res., vol. 1, pp. 60-61, 1916.—VITZTHUM, Zool. Jahrb. (Abt. Syst.), vol. 60, pp. 402-403, 1931.

*Haemogamasus horridus* var. *arvicolarum* BERLESE, Redia, vol. 14, p. 166, 1920.

*Haemogamasus arvicolarum* (Berlese) TURK, Ann. Mag. Nat. Hist., ser. 2, vol. 12, pp. 785-820, figs. 119-122, 1945.

*Female*.—Setae of dorsal shield about  $15\mu$  apart and of nearly uniform size, varying between  $40\mu$  and  $60\mu$  in length; usual apical setae clearly the largest setae on shield. Setae of apical region little larger than others; all setae on shield smooth; five pairs of pores on shield. Setae of unprotected dorsal integument larger than those of shield, particularly at lateral and posterior body margins, where some may be barbed; three or four terminal pairs distinctly larger than other marginal setae. Lacinae of tritosternum barbed; a spine on each side of base of tritosternum about midway on its length. Presternal area sculptured and applied to entire anterior margin of sternal shield; sutures of presternal area with tiny spines. Sternal shield strongly sculptured; slightly longer than wide, with a nearly straight posterior margin; all sternal setae large, stout, and smooth; anterior flank middle third of anterior margin of shield. Anterior pair of sternal pores posterior and slightly lateral to bases of anterior pair of sternal setae; a few anterior sutures of shield with tiny spines; anterior and posterior pairs of seta about equidistant from middle pair. Genitoventral shield strongly sculptured; with a nearly straight posterior margin in some specimens; usual pair of genitoventral setae smooth and smaller than sternal and metasternal setae; accessory setae smaller, smooth and present over most of shield posterior to usual setae; in five available specimens accessory setae number 35, 60, 65, 65, and 70. Anal shield between one and a half and two times as long as it is wide; in addition to the three usual anal setae about 10 smaller accessory setae are present; of five available specimens, two possess 10 accessory setae and three 11; pattern of setation of accessory setae variable; posterior usual seta is largest on shield. Endopodal shields short. Metapodal shields rodlike. Shape of posterior end of peritreme distinctive; tubular portion extends to level of anterior margin of coxae III. Ventral



body setae larger than those of dorsal shield and unprotected dorsal integument; they tend to be larger and more often barbed at the posterior body margin. Metasternal setae at least as large as posterior pair of sternal setae. Epistome distinctive, with a gently rounded

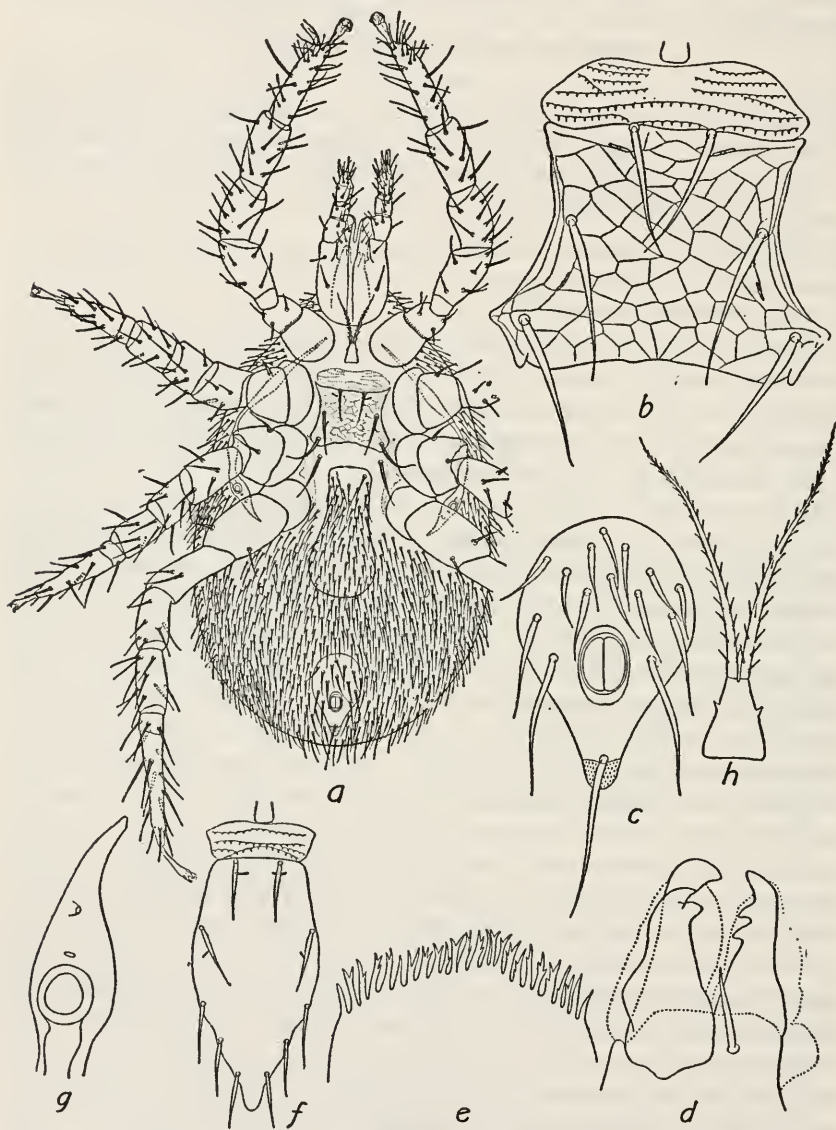


FIGURE 47.—*Euhaemogamasus horridus* (Michael): *a*, Ventral view of female; *b*, sternal shield of female; *c*, anal shield of female; *d*, chelicera of female; *e*, epistome of female; *f*, ventral shield of nymph; *g*, posterior end of peritreme of female; *h*, tritosternum of female.



anterior margin of simple and multiple fimbriae, which are more numerous than in other species. Chelicerae are difficult to determine accurately; both are thick and possess bursae, which may vary in shape. Each chela with two teeth; a seta at base of fixed chela and another between its teeth. Corniculi of maxillae blunt; maxillary setae smooth. Only barbed setae on palps are single, stout ventral seta on each coxa. Seta on legs distinctly more slender dorsally; many of the stout ventral setae with rough surfaces, but none examined were truly barbed; distal margins of most leg segments serrated.

*Male*.—No male specimens were available for study. According to Oudemans (1913), the male may be identified as that of *horridus* because of the following characteristics: Dorsal setation as in female; dorsal shield covers almost entire dorsal surface. Tritosternum as in female; setation of ventral shield as in female. Lateral margins of shield are not distinct in Oudemans' figure but appear to curve anteriorly lateral to coxae IV. Structure of peritreme not mentioned or figured clearly. Epistome as in female. Chelicerae not clearly figured. Fixed chela with two teeth according to Michael (1892). Maxillae not clearly figured. Legs as in female; without enlarged setae.

*Nymph*.—Dorsal shield with a slitlike invagination on each lateral margin at level of coxae IV; setation as in female; pores are not visible. Tritosternum and presternal area as in female. Pattern of setation and position of pores on ventral shield as in female; setae on shield smooth; distinctive in that genitoventral setae, in addition to sternal and metasternal setae, are on shield. Anal shield with three usual setae and three most anterior accessory setae. Epistome as in female. Chelicerae as in female. Maxillae not clear. Palpi and legs as in female.

*Remarks*.—Distinctive characteristics of female, male, and nymph of *E. horridus* are: FEMALE: All setae of dorsal shield smooth; usual apical setae clearly largest on shield; three or four pairs of large terminal setae at posterior body margin; five pairs of pores present; anterior pair of sternal setae flank middle third of anterior margin of shield; all sternal setae smooth; posterior margin of genitoventral shield nearly straight in some specimens; about 10 accessory setae on anal shield; epistome with many slender fimbriae and with a gently rounded anterior margin; chelae stout and possess membranous bursae; each chela with two teeth; maxillary corniculi blunt; all maxillary setae smooth; stout, ventral coxal seta is only barbed seta on palp; setae on legs not barbed, but with conspicuously rough surfaces; setae large; ventral setae stouter; distal margins of most leg segments serrated. MALE: Setation of dorsal and ventral surfaces

and structure of epistome as in female; legs as in female, with no enlarged setae or other evidences of sexual dimorphism. **NYMPH:** Setation, mouth parts, and legs as in female; differs from nymphs of other species in that genitoventral setae are on ventral shield.

Oudemans (1913) figures the adult female of this species as possessing only the three usual setae on the anal shield. However, Michael (1892) figures about 13 accessory setae, and Hirst (1916) reports 14 anal setae from one specimen and 9 on another. Vitzthum (1931) comments that 6 to 11 accessory setae had been reported on specimens of this mite taken in Great Britain.

Although both Oudemans and Vitzthum describe specimens examined by them as possessing only smooth setae, many dorsal and ventral body setae are barbed in specimens that I examined.

**Size.**—Four females in the U. S. National Museum collection measure  $1,372\mu$ ,  $1,400\mu$ ,  $1,442\mu$ , and  $1,512\mu$  in length. It was impossible to obtain accurate measurements of width. The only nymphal specimen available was  $994\mu$  in length. Michael gave the length of the female of this species as about  $1,400\mu$  and that of the male as  $1,160\mu$ ; width of female  $770\mu$ ; of male  $650\mu$ . Vitzthum gives the length of the female as  $1,530\mu$ ; of the male as  $1,270\mu$ .

**Distribution and hosts.**—Michael's original description was based upon specimens taken from nests of the mole *Talpa europea* in Great Britain. Oudemans reported it from rodent nests in Holland; Hirst from field mice and their nests in Great Britain; and Vitzthum describes this species as a parasite of mice and moles of various species in western Europe. I have examined specimens as follows: from nest of *Apodemus flavicollis*, Ratece, Slovenia, August 14, 1931; *Talpa alpina*, Ratece, Slovenia, July 12, 1931; *Apodemus sylvaticus*, North Bull, Dublin, Eire, October 6, 1946 (E. W. Jameson collection); "mouse nest," Hell Coppice, near Oakley, Bucks, England, August 17, 1941 (E. W. Jameson collection).

**Status of *H. arvicolarum* (Berlese).**—Berlese (1920) described *arvicolarum* as a variety of *horridus* on the basis of specimens taken from nests of *Arvicola arvalis* at Ferrara, Italy, and Asuni, Sardinia. These differed from *horridus*, as described by Michael, in the following respects: Somewhat smaller; legs relatively shorter and thicker; terminal body setae no longer than other marginal setae; chelae of female stronger than in *horridus*: leg II of male with enlarged ventral setae. Length of female was given as  $1,300\mu$ ; that of male as  $1,060\mu$ . No figures were given. None of Berlese's material was available for study.

Turk (1945) found the characteristics described by Berlese in a series of specimens taken from the nest of *Apodemus sylvaticus sylvaticus*.

*ticus* at North Bull, County Dublin, Eire. After comparing these specimens with those taken from nests of mice in England, he concluded that these mites from Eire represented the form described by Berlese and that because of their morphological differences from *horridus* their restricted habitat in nests of voles and field mice, and their distribution in Eire and the Mediterranean area, they represented a distinct species.

In addition to the diagnostic features of *arvicolarum* given by Berlese, Turk included the following points: Length of female 1,300 $\mu$ ; sternal shield as in *horridus*; genitoventral shield as in *H. nidi* rather than *horridus* in being flask-shaped and somewhat expanded posteriorly, rather than with almost straight lateral margins and a truncate posterior margin; anterior portion of shield with two pairs of setae; anal shield larger than in *horridus* and with 14 setae; chelae of female stronger and more elongate than in *horridus*; chelae of male differ in some respects from those of *horridus*; average length of male 1,200 $\mu$ .

I have seen no male specimens of *horridus* or of *arvicolarum*, but through the kindness of Dr. Turk I was able to examine four female specimens of *arvicolarum* taken from the type locality and habitat. Two of these were engorged, but morphological details of the others were distinct.

These specimens lack distinctly enlarged terminal body setae; chelae are slightly more elongate than those figured by Michael and Oudemans, or of the four specimens of *horridus* examined; anal shield is relatively large; distinctive in possessing 35 and 39 accessory setae on the genitoventral shield and in having the sternal shield slightly wider than long. Although the genitoventral shield of one specimen is expanded posteriorly, that of the other possesses relatively straight lateral margins and a truncate posterior margin.

Morphological variations, individual as well as among local populations, are indicated in the published descriptions of *horridus*. Variations in numbers of anal setae and in occurrence of smooth and barbed body setae have been discussed. Of four specimens typical of *horridus* from Ratece, Yugoslavia, two possess flask-shaped genitoventral shields and two possess the truncated posterior margin and more nearly straight lateral margins.

In my opinion structural differences such as those by which *arvicolarum* was separated from *horridus* by Berlese and Turk are not sufficient in themselves to warrant specific or subspecific status. Studies of morphological variation of *horridus* throughout its range, including Eire, will be necessary before the taxonomic value of such characters can be determined.



## EUHAEMOGAMASUS OUDEMANSI (Hirst)

FIGURES 48, 49

*Haemogamasus oudemansi* HIRST, Bull. Ent. Res., vol. 5, pp. 122-123, pls. 14-16, 1914.—VITZTHUM, Zool. Jahrb. (Abt. Syst.), vol. 60, pp. 401-402, 1931.

*Eulaelaps mawsoni* WOMERSLEY, Australasian Antarctic Exped. 1911-1914: Scientific Rep., ser. C, Zool. and Bot., vol. 10, pt. 6, p. 19, pl. 12, figs. 4-7, 1937.

*Female*.—Dorsal shield widest at level of coxae II, not covering entire dorsal surface; with six pairs of pores. Usual pair of apical setae barbed and clearly largest setae on shield. Setae of shield relatively sparse,  $30\mu$  to  $60\mu$  apart and about  $45\mu$  in length; only usual pair of apical setae barbed. Base of each seta of unprotected dorsal integument with a spinelike posterior elongation; these setae slightly larger than those on shield; a few at lateral and posterior body margins barbed. Lacinae of tritosternum heavily barbed. Sutures of presternal area with spines. Sternal shield distinctive in that its posterior margin is invaginated to a level about midway between anterior and middle pairs of sternal setae. Anterior pair of sternal setae barbed. Shield sculptured; anterior pair of sternal pores nearly parallel with anterior margin of shield. Genitoventral shield relatively large and widely expanded posterior to coxae IV; extends more than two-thirds of distance between coxae IV and anal shield; possesses usual genitoventral setae and 10 to 20 accessory setae in a series of 14 specimens examined; mean was 15; all accessory setae are posterior to usual genitoventral setae and are smaller than the latter; usual genitoventral setae are smaller than sternal setae; all setae on shield are smooth. Anal shield nearly four-fifths as wide as long; possesses only the three usual anal setae; two small prominences are on the anterior margin of the shield. Anus about half its length from anterior margin of shield; posterior unpaired seta longest; all are smooth. Endopodal shields lacking. Metapodal shields long irregular rods or ovals. Peritreme distinctive in possession of a fenestra or invagination on median surface of posterior end in most specimens; posterior end of peritreme joined with coxal fovea; tubular portion extends to level of posterior third of coxae II. Metasternal setae smaller than sternal setae and larger than genitoventral setae. Ventral body setae with posteriorly elongate bases; about as large as dorsal setae but may be larger, more often barbed on posterior body margin. Epistome a slender, pointed spike; fimbriae simple on proximal portion of epistome, branched on its distal margin. Chelae about equal in length; fixed chela may be slightly the larger. Fixed chela nearly straight; with a bifid tip and one tooth; a slender seta between tip and tooth. Movable chela with a sharply curved tip and with two teeth. Anterior pair of maxillary setae smooth, the others barbed. Palpi with both barbed and smooth setae; most ventral setae barbed,



including those on coxa. Many barbed setae on legs. Stout ventral setae on leg II, III, and IV are distinctive. Legs relatively long and slender. Length-width ratios of tarsi are: Leg I 8:1, leg II 6:1, leg III 7:1, leg IV 9:1.

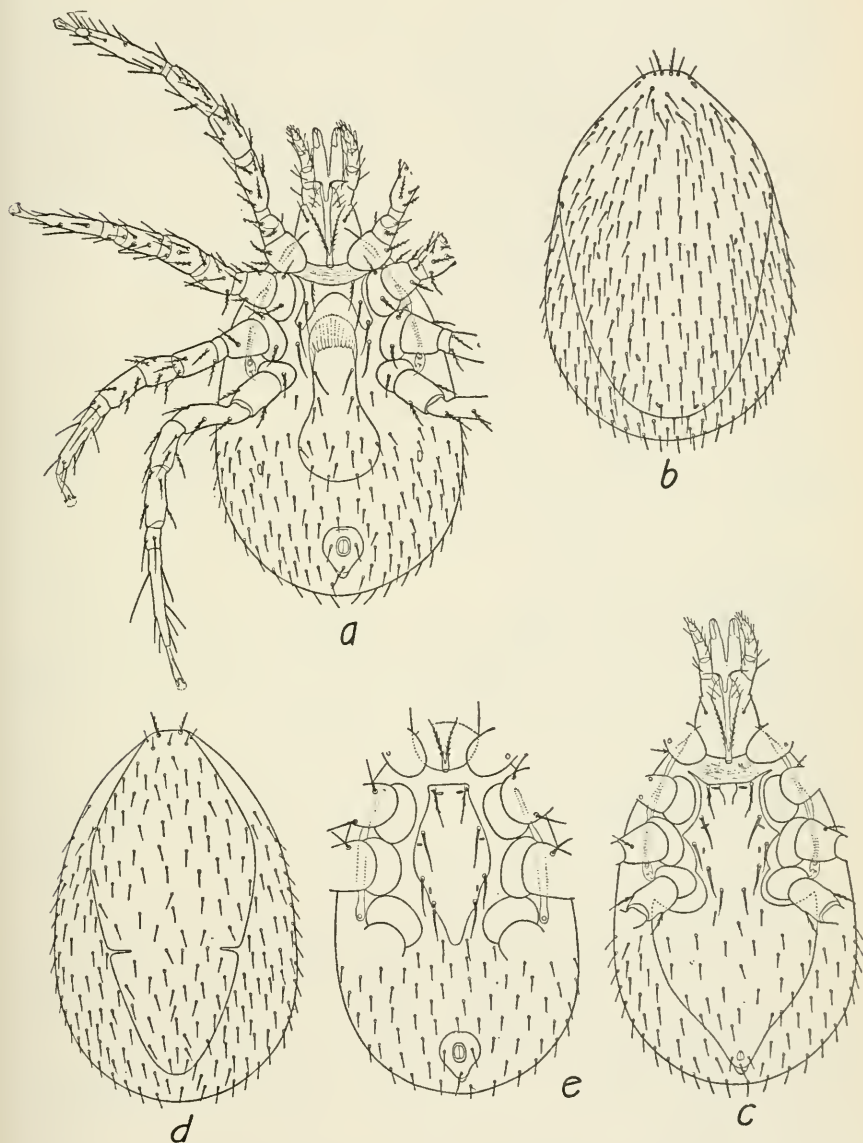


FIGURE 48.—*Euhaemogamasus oudemansi* (Hirst): *a*, Ventral view of female; *b*, dorsal view of female; *c*, ventral view of male; *d*, dorsal view of nymph; *e*, ventral view of nymph.

*Male*.—Only about two-thirds as large as female and relatively more narrow. Setation and pores of dorsal shield as in female. Setae of unprotected dorsal integument as in female. Ventral shield

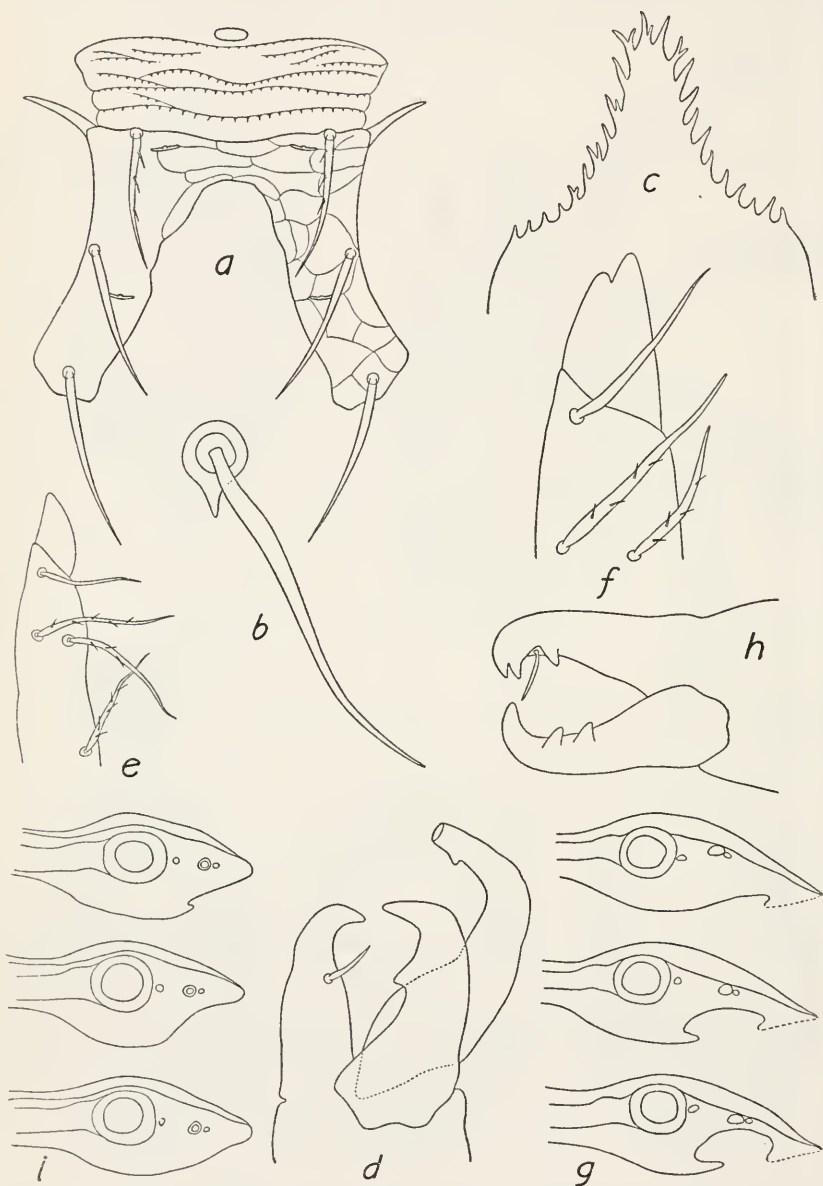


FIGURE 49.—*Euhaemogamasus oudemansi* (Hirst): *a*, Sternal shield of female; *b*, body seta of female; *c*, epistome of female; *d*, chelicera of male; *e*, cornicula of female; *f*, cornicula of male; *g*, peritremes of three female specimens; *h*, chelicera of female; *i*, peritremes of three male specimens.

widely expanded posterior to coxae IV and curved anteriorly lateral to coxae; does not cover entire ventral surface; setation as in female; pores as in female except that middle pair of sternal pores are not horizontal; anal region not abruptly set off from remainder of shield. Peritreme not joined to coxal fovea as in female; only an indication of the median invagination of the female. Epistome very faint; apparently fimbriated, but details could not be seen. Chelicerae display marked sexual dimorphism. Fixed chela toothless, but with a distal seta as in female. Movable chela divided near its base into two branches; the shorter branch has a curved, pointed tip and bears one tooth about midway on its length; the longer branch is twisted and is bent at a right angle distally; possesses a truncated tip and a tiny spur near the tip. Maxillary setae as in female; notched corniculi distinctive. Palpi as in female. Legs as in female, both in relative size and setation.

*Nymph.*—Dorsal shield more narrow than in adults and with a slit-like invagination on each side at level of coxae IV; setation as in female. Setae of unprotected dorsal integument as in adults. Tritosternum and presternal area as in adults. Setation and pores of ventral shield as in female, except that posterior pair of sternal setae are more median in position. Anal shield as in female. Peritreme not well developed. Epistome, chelicerae, palpi, and legs as in female.

*Remarks.*—Distinctive characteristics of *E. oudemansi* that make it possible to distinguish female, male, and nymph from those of other species are: **FEMALE:** Sparse setation and six pairs of pores on dorsal shield; deeply invaginated posterior margin of sternal shield; small number of setae on genitoventral and anal shields; median invagination of posterior margin of peritreme; spikelike epistome. **MALE:** Sparse dorsal and ventral setation as in female; distinctive structure of peritreme, epistome, chelicerae, and maxillae; setation as in female. **NYMPH:** Sparse setation, mouth parts as in female.

The description given above differs from that given in Hirst's paper in a few details. Hirst does not mention or figure the distinctive pores on the dorsal shield, and he figures the anterior pair of maxillary setae as barbed, whereas they are clearly smooth in all specimens in the U. S. National Museum collection. Neither does he mention the structure of the peritreme nor figure it clearly. His figure of the anal shield does not include the distinctive anterior prominences found on all specimens examined. His figure of the chelicerae differs slightly from the condition found in specimens examined. He does not figure or mention the invagination on the lateral margins of the shield of the nymph.

Womersley's *Eulaelaps mawsoni*, as figured in his 1937 paper, is undoubtedly *E. oudemansi*.

*Size*.—Seven measurable females varied from  $770\mu$  to  $952\mu$  in body length; the mean was  $856$ . It was impossible to obtain an accurate measurement of body width. Three males were  $700\mu$ ,  $686\mu$ ,  $658\mu$  in length; the width of the first two specimens was  $364\mu$ . Two nymphs measured  $630\mu$  and  $616\mu$  in length; the latter was  $350\mu$  in width. Hirst (1916) gives the length of the female as  $1,100\mu$ , the male  $760\mu$ , and the nymph  $750\mu$ .

*Distribution*.—Cosmopolitan; reported from England and South Africa by Hirst (1914) and from Maccuarie Island in the Australian Antarctic region by Womersley (1937). There are specimens in the U. S. National Museum collection from France, Holland, Italy, Portugal, and China. It has been taken in the United States at Ward, Colo., and in New York.

*Hosts*.—This species is apparently a facultative parasite. Hirst (1914) reported it from wild rats and raised numerous specimens on laboratory mice and rats. He also reported the species as taken from a bat in South Africa, from a mole's nest in England, and as free living in England. Specimens examined were found in a variety of habitats: Wheat straw, flax tow, rice straw, rice hulls, in sod, and associated with the clothes moth. It has been taken only three times in the United States: Once from a nest of *Tamiasciurus fremonti* at Ward, Colo., once associated with clothes moths in New York, and once on a rug in the same State. I have examined specimens as follows: On *Tigridia* bulbs, Holland, intercepted at quarantine at Philadelphia, Pa., May 13, 1946; wheat-straw jacket, France or Germany, at Cleveland, Ohio, August 10, 1945; in sod, Scotland, at New York, August 10, 1944; with flax tow, "Pacific area," Cleveland, Ohio, July 24, 1945; in wheat straw, Italy?, at Cleveland, Ohio, December 20, 1944; in straw jackets, Portugal, at Los Angeles, Calif., January 14, 1944; on rye-straw jacket, Scotland, at Buffalo, N. Y., September 29, 1938; in rye-straw packing, Portugal, at Portland, Oreg., July 8, 1944; in rice hulls, China, at Chicago, Ill., September 4, 1924; associated with clothes moth, New York, November 1928; in *Tamiasciurus fremonti* nest, Ward, Colo., July 2, 1940; on rug, New York, April 12, 1930; on *Marrubium vulgare*, Italy, at New York, May 25, 1936; on *Juncus* sp., Portugal, at Boston, Mass., July 5, 1944.

EUHAEMOGAMASUS LIPONYSSOIDES (Ewing)

FIGURE 50

*Haemogamasus liponyssoides* EWING, Proc. Biol. Soc. Washington, vol. 38, pp. 139-140, 1925.—VITZTHUM, Zool. Jahrb. (Abt. Syst.), vol. 60, p. 402, 1931.  
*Euhaemogamasus liponyssoides* (Ewing) SPENCER, Proc. Ent. Soc. British Columbia, vol. 37, p. 15, 1941.

*Female*.—Dorsal shield sculptured; widest at level of coxae III. Usual pair of apical setae clearly largest on shield, flanked by two



pairs of smaller setae, one smaller seta between them. Setae of apical region larger than on remainder of shield; about  $45\mu$  in length and  $9\mu$  to  $45\mu$  apart; all setae on shield smooth. Setae of unprotected dorsal integument larger than those on shield, especially at posterior body margin; all are smooth. Lacinae of tritosternum smooth. Pre-sternal area sculptured; sutures with tiny, posteriorly directed spines; in contact with slightly more than median third of the anterior margin of sternal shield. Posterior margin of sternal shield invaginated to a level about midway between posterior and middle pairs of usual sternal setae. Anterior pair of sternal setae on anterior margin of shield at junction of its lateral and median fourths; middle and posterior pairs of setae not on lateral margins of shield; middle pair of setae at least once and a half as far from posterior as from anterior pair, which are the smallest of the three. Anterior pair of sternal pores nearly parallel with another margin of shield. Genitoventral shield sculptured; relatively narrow; only slightly expanded posteriorly; usually about as wide as distance between coxae IV; accessory setae much smaller than usual genitoventral setae and distinctly posterior to the latter; in a series of 36 specimens numbers of accessory setae varied from 19 to 41. Only one specimen had more than 27 setae, and most possessed between 21 and 26; mean number in the series was 23.5. The anterior setae are slightly larger than those at the posterior margin of the shield; almost all setae are in posterior half of shield; all are smooth. Anal shield not quite as long as it is wide; in all but two of the specimens examined seven accessory setae and three usual anal setae were present. Accessory anal setae about as large as usual setae, although the most anterior accessory setae may be smaller than the others. Unpaired, usual anal seta is at posterior margin of shield proper and is largest seta on shield; all are smooth. Anus almost entirely in posterior half of shield. Metapodal shields irregular, almost always longer than wide. Endopodal shields present. Tubular portion of peritreme extends to posterior half of coxae II, posterior end of peritreme fused with fovea of coxa IV; of distinctive shape. Metasternal setae smooth and as large as posterior pair of sternal setae. A pair of longitudinal pores slightly anterior to bases of these setae. Ventral body setae larger than those of dorsal shield, especially at posterior body margin; all are smooth. Epistome narrow; with 7 to 10 usually simple, lateral fimbriae on each side and four or five branched distal fimbriae. Both chelae toothless; of about equal length. Movable chela may be slightly larger. Fixed chela nearly straight but gently curved in its distal third; terminates in a point, which may be filamentous, and bears a pilus dentilis at its base. Movable chela wider, rodlike, terminating in a blunt tip, and grooved

and twisted on its longitudinal axis; it possesses membranous margins and is much wider than fixed chela. All maxillary and palpal setae smooth. Length-width ratios of tarsi of legs are: Leg I 6:1, leg II 4:1, leg III 6:1, leg IV, 8:1. All setae on legs are smooth.

*Male*.—Dorsal shield covers entire dorsal surface; setation as in female. Tritosternum and presternal area as in female. Ventral shield not covering entire ventral surface; expanded posteriorly to lateral margins of coxae IV; tapering gradually to a point in the anal region; bearing sternal, metasternal, usual, and accessory genito-ventral setae and usual and accessory anal setae. Setae like those of female in size and position. Sternal pores as in female. Peritreme and epistome as in female. Chelicerae as in female except that proximal seta of fixed chela is lacking. Absence of sexual dimorphism is distinctive. Maxillae and palpi as in female. Relative size and setation of legs as in female; femur, genu, tibia, and tarsus of leg II each possess a conspicuously heavy ventral seta on tarsus with a thick proximal and slender distal portion. Length-width ratios of tarsi are: Leg I 6:1, leg II 4 or 4.5:1, leg III 6:1, leg IV 9:1 or 10:1.

*Nymph*.—Dorsal shield narrower than in female; setation as in adults; tritosternum and presternal area as in adults. Sternal shield with sternal and metasternal setae. Usual genitoventral setae flank posterior end of shield; setae as in adults in relative size and position, except that middle pair of sternal setae are on lateral margins of shield. Anal shield as in female but with only three usual and five anteriormost accessory setae; as in adults the posterior usual setae is largest on shield. Metapodal shields and ventral setation as in female. Peritreme not well developed. Epistome as in adults, but with fewer fimbriae, most of which are branched. Chelicerae, maxillae, and palpi as in adults. Relative size and setation of legs as in female.

*Remarks*.—Distinctive characteristics of *E. liponyssoides* that serve to distinguish female, male, and nymph from those of other species are: FEMALE: All setae smooth; lacinae of tritosternum smooth; presternal sutures with spines; posterior margin of sternal shield invaginated to level of midpoint between posterior and middle pairs of sternal setae; genitoventral accessory setae between 19 and 41 in number; in most specimens between 21 and 26; mean number 23.5; 7 accessory setae on anal shield; posterior usual anal seta largest on shield; shape of peritreme distinctive; epistome with 7 to 10 usually simple lateral fimbriae on each margin, and four or five branched distal fimbriae; both chelae toothless; a seta at proximal end of fixed chela. MALE: Dorsal shield covers entire dorsal surface; setation as in female except on leg II, on which femur, genu, tibia, and tarsus each possess

a conspicuously stout ventral setae; that on tarsus II with a thick proximal portion which abruptly narrows into a slender spike; ventral shield expanded posteriorly to lateral margins of coxae IV, from which it tapers to a point at the anal region; peritreme, epistome, and chelicerae as in female except that proximal seta of fixed chela is lack-

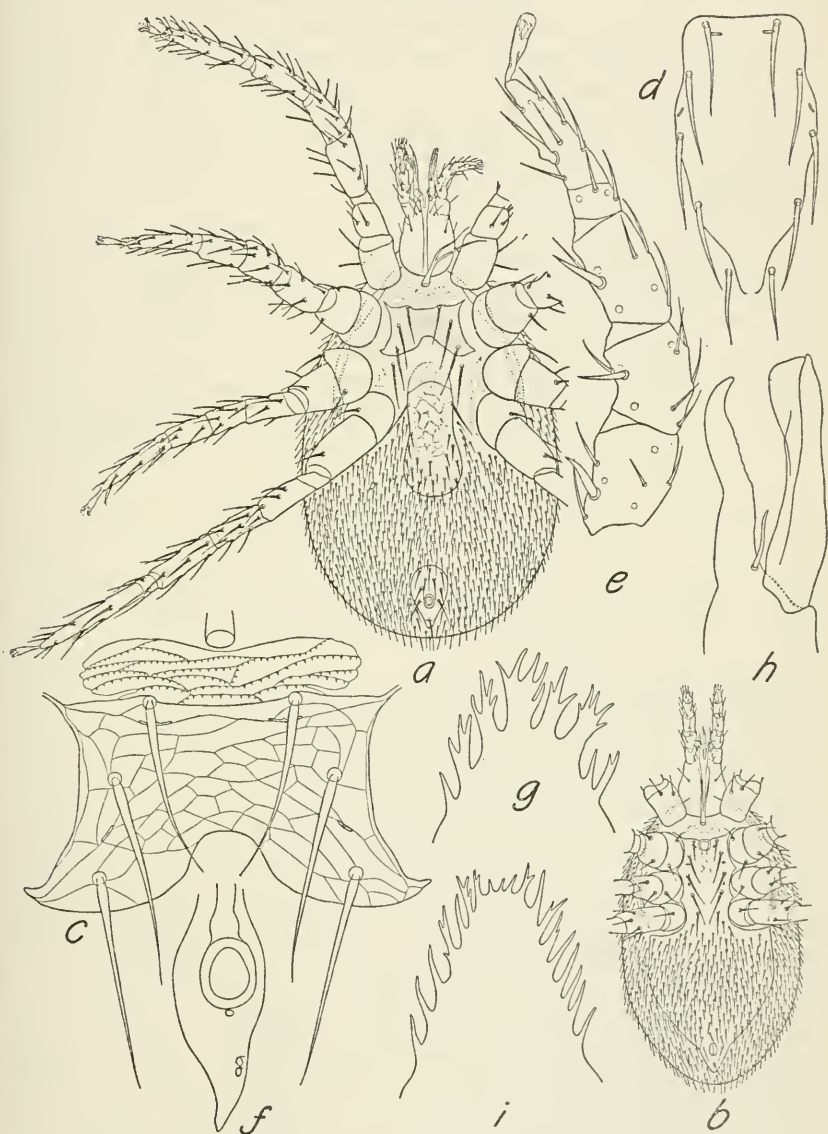


FIGURE 50.—*Euhaemogamasus liponyssoides* (Ewing): *a*, Ventral view of female; *b*, ventral view of male; *c*, sternal shield of female; *d*, ventral shield of nymph; *e*, ventrolateral view of leg II of male; *f*, posterior end of peritreme of female; *g*, epistome of nymph; *h*, chelicera of female; *i*, epistome of female.



ing; maxillae and palpi as in adults. NYMPH: Dorsal shield narrower than in female; setation as in adult female; tritosternum and peritremal area as in adults; setation of sternal shield as in adults; anal shield with three accessory and three usual anal setae; posterior usual seta largest on shield; mouth parts as in female; legs as in female.

*Size*.—In a series of 32 female specimens body length varied from  $952\mu$  to  $1,148\mu$ ; body width from  $546\mu$  to  $686\mu$ . Mean length was  $1,047\mu$ ; mean width  $616\mu$ . Nine males varied from  $784\mu$  to  $868\mu$  in body length and from  $427\mu$  to  $504\mu$  in body length. Mean length was  $833\mu$ ; mean width  $482\mu$ . Body length in a series of 35 nymphs varied from  $560\mu$  to  $756\mu$ ; mean length was  $658\mu$ ; mean width  $370\mu$ . Ewing's type female measured  $1,080\mu$  in length.

*Distribution and hosts*.—This species has been taken from several of the eastern and southern United States and southern Canada. It has been reported only twice west of the Mississippi River. I have examined specimens as follows: *Blarina brevicauda talpoides*, Fairfield County, Ohio, April 23, 1935; Ithaca, N. Y., April 20, August 30, October 3, 1936, and November 29, 1947; Lucerne-in-Maine, Maine, November 3, 1928. *Blarina brevicauda*, Ithaca, N. Y., September 10, 1936, March 21, 1943; Wayne County, Pa., July 7 and 23, 1945; District of Columbia, September 17, 1929; Point Abino, Welland County, Ontario, September 9 and 11, 1946. *Blarina brevicauda compacta*, Nantucket, Mass., June 13, 1936. *Blarina brevicauda aloga*, West Tisbury, Mass., June 9, 1936. *Microtus ochrogaster* nest, Urbana, Ill., April 9, 1939. *Peromyscus* (or *Microtus*) nest, Chilmark, Mass., February 14, 1939. *Microtus pennsylvanicus pennsylvanicus*, Ithaca, N. Y., March 26, 1936; Scraggy Neck, Mass., June 18, 1936; Edgartown, Mass., June 14, 1936, November 13, 1937; Squibnocket, Mass., June 11, 1936. *Microtus pennsylvanicus*, Temagami, Ontario, September 8, 1934. *Peromyscus gossypinus gossypinus*, Okefinokee Swamp, Ga., January 28, 1936; Yemassee, S. C., August 10, 1938; St. Mathews, S. C., January 30, 1935. *Peromyscus maniculatus gracilis*, Temagami, Ontario, September 8, 1934. *Peromyscus leucopus noveboracensis*, Somerset, Md., June 9, 1933. *Sorex palustris albibarbis*, Mount Katahdin, Windy Pitch, Maine, August 23, 1928. *Sorex fumeus*, Mount Watatic, Ashburnham, Mass., October 12, 1933. *Sorex cinereus*, Ithaca, N. Y., July 24, 1947. *Sorex palustris*, Montana, September 25, 1948 (U. S. P. H. S. collection, Hamilton, Mont.). *Parascalops breweri*, Point Abino, Welland County, Ontario, September 16, 1945. *Pitymys pinetorum*, Point Abino, Welland County, Ontario, September 4, 1945. *Condylura cristata*, Leetonia, Ohio, September 14, 1934. *Rattus norvegicus*, District of Columbia, February 28, 1946. *Clethrionomys gapperi rhoadsi*, Mays Landing, N. Y., May 16, 1931. *Sigmodon hispidus hispidus*, Grady County, Ga., January 8, 1947; Thomas County,



Ga., January 29 and 31, 1947 (C. D. C. collection, U. S. P. H. S. Thomasville, Ga.). *Didelphis virginiana pigra*, Decatur County, Ga., March 27, 1947. *Scalopus aquaticus howelli*, Decatur County, Ga., January 1947. "Short-tailed shrew," Riverdale, Md., June 3-4, 1934; Vineyard Haven, Mass., April 20, 1938; Silver Spring, Md., July 17, 1930; Takoma Park, Md., July 15, 1933; University Park, Md., June 27, 1936. "Shrew," Hockessin, Del., May 5, 1939. "Pine mouse," University Park, Md., June 27, 1936; Somerset, Md., June 8, 1938. "Meadow mouse," Menansha, Mass., August 29, 1936; Seaford, Del., May 12, 1936; Nantucket, Mass., August 31, 1936. "White-footed mouse," Riverdale, Md., June 8, 1938; Somerset, Md., January 17, 1934; Mechanicsville, Md., August 7, 1933. "Red-backed mouse," Smoke Mountain, N. C., April 17, 1931. "Cotton mouse," Dale County, Ala., May 18, 1937. "Mole," Laurel, Md., May 12, 1939. "Maryland shrew," Chestertown, Md., April 12, 1933; Laurel, Md., November 25, 1952, May 12, 1939. Host?, Urbana, Ill., October 18, 1937.

*Types*.—One male and several females, on slide, U. S. N. M. No. 948, collected from *Scalops argentatus* at Ames, Iowa, by J. E. Guthrie in July 1916.

**EUHAEMOGAMASUS BARBERI (Ewing)**

**FIGURE 51**

*Haemogamasus barberi* EWING, Proc. Biol. Soc. Washington, vol. 38, pp. 140-141, 1925.

*Haemogamasus microti* EWING, Proc. Biol. Soc. Washington, vol. 38, pp. 141-142, 1925.

*Female*.—Dorsal shield covers nearly entire dorsal surface and is thickly covered with setae, most of which are  $9\mu$  to  $30\mu$  apart and about  $45\mu$  in length. Usual pair of apical setae barbed and clearly largest setae on shield. Most setae smooth, although some at lateral and posterior margins of shield possess one or two barbs. Six pairs of pores on shield. Most setae of unprotected dorsal integument barbed and larger than those on shield; one or two pairs at posterior body margin are larger than the others, but are slenderer than usual apical setae. Lacinae of tritosternum distinctly barbed. Presternal area sculptured and applied to entire anterior margin of sternal shield; sutures with tiny spines. Sternal shield about two-thirds as long as wide, its anterior margin nearly straight and its posterior margin slightly concave. Anterior pair of sternal setae shorter than others and the only barbed setae on shield; three pairs of pores on shield; the anterior pair with median ends directed posteriorly at a distinct angle; posterior pair on posterior margin of shield. Genitoventral shield distinctive in being widely expanded posterior to coxae IV. Usual geni-

toventral setae only slightly larger than more anterior accessory setae, the latter present over the entire surface of the shield and slightly larger on the anterior portion of the shield; all setae smooth; outline of bulbous portion of shield varies individually; the large number of

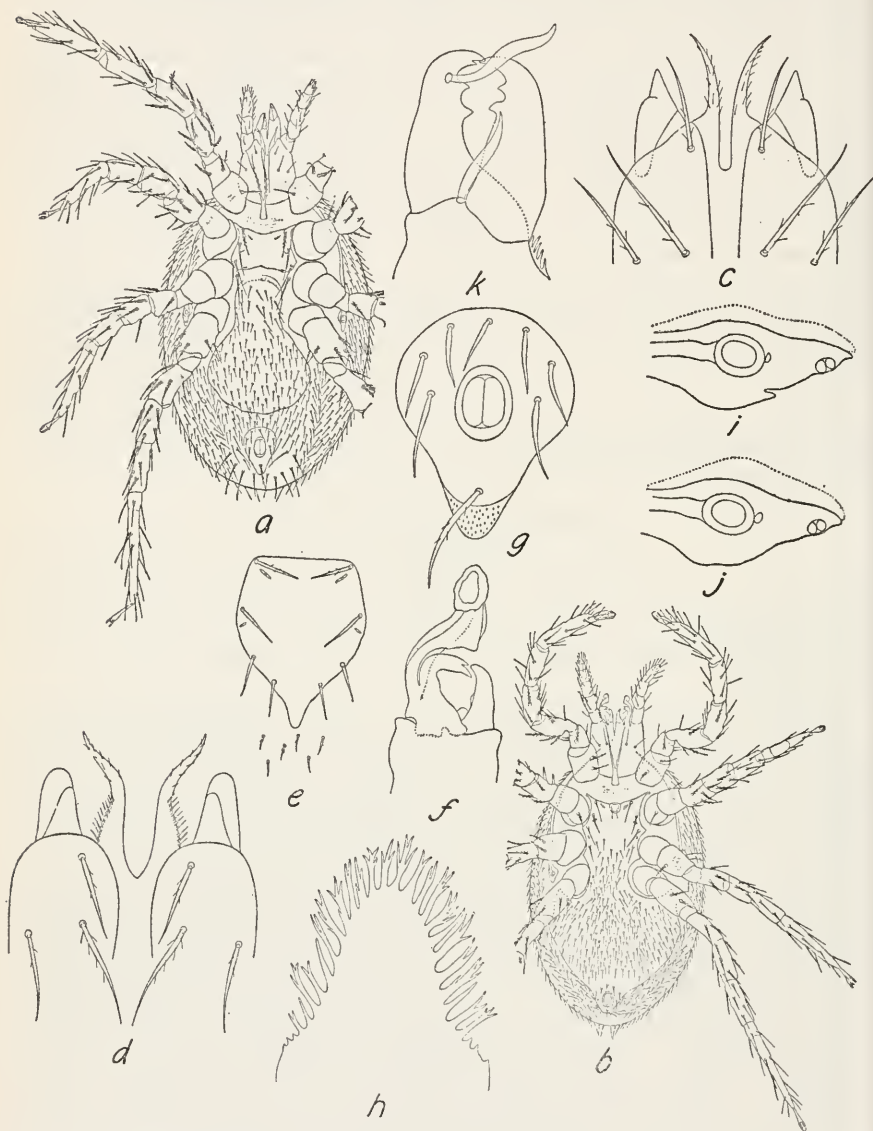


FIGURE 51.—*Euhaemogamasus barberi* (Ewing): *a*, Ventral view of female; *b*, ventral view of male; *c*, corniculi of female; *d*, corniculi of male; *e*, ventral shield of nymph; *f*, chelicera of male; *g*, anal shield of female; *h*, epistome of female; *i*, posterior end of peritreme of male; *j*, posterior end of peritreme of female; *k*, chelicera of female.

accessory setae, over 100 in all specimens examined, is distinctive, these setae larger than those of dorsal shield. Anal shield with three usual anal setae and five smaller, accessory setae; posterior usual seta barbed, largest on shield, and set distinctly anterior to cribrum. Endopodal shields slender. Metapodal shields small and spindle-shaped in most specimens. Tubular portion of peritreme extends to anterior margin of coxae II; the median spur and invagination on posterior end of peritreme distinctive; posterior pores on median margin of peritreme. Metasternal setae smooth and about as large as anterior pair of sternal setae. Ventral body setae larger at margins of body, where many are barbed; one or two distinctly larger pairs at posterior body margin. Either lateral margin of epistome with about 12 fimbriae, most of which are multiple; epistome relatively broad. Fixed chela with a bifid tip, two teeth, an inflated laterally placed seta between tip and teeth, and a proximal seta. Movable chela stouter; possesses two teeth and a proximal, ventral, fringe of setae, the extent of which is difficult to determine. All maxillary setae barbed; maxillary corniculi narrow and slightly indented laterally. Many palpal setae barbed. Almost all setae on legs barbed; difference in size of dorsal and ventral setae not so great as in many species. Length-width ratios of tarsi are: Leg I 7:1, leg II 6:1, leg III 6.5:1, leg IV 8:1.

*Male*.—Dorsal shield covers almost entire dorsal surface; setation and pores as in female. Setae of dorsal integument, tritosternum, and presternal area as in female. Ventral shield widely expanded posterior to coxae IV and curved anteriorly lateral to coxae IV. Anal region distinct; accessory setae present as far anterior as level of posterior pair of sternal setae. Deeply angled anterior sternal pores as in female; setation throughout shield as in female. Ventral body setae as in female. Peritreme lacks median spur of female. Epistome as in female. Chelae show sexual dimorphism. Fixed chela lacks teeth but possesses a seta about midway on its length. Movable chela greatly modified; divided midway on its length into two branches, the shorter of which has a curved, distally bifurcate tip and lacks teeth; the larger branch, also toothless, is funnel-shaped and twisted on its longitudinal axis; a bursa and possibly setae present at base of fixed chela. Maxillary corniculi more blunt than in female. Palpi as in female. Setation of legs as in female except on leg II, where two conspicuously stout ventral setae were present on femur, one on genu, one on tibia, and two on tarsus. Legs may be relatively shorter than in female.

*Nymph*.—The only nymphal specimen is crushed, and an exact description is impossible. The resemblance of the epistome, chelicerae, and maxillae to those of the adult female indicates that it is the nymph of *barberi*. Although the ventral shield is very difficult

to determine, its setae and pores are as in adults; many setae of dorsal and ventral integument barbed; peritreme not well chitinized.

*Remarks.*—Distinctive characteristics that make it possible to distinguish female, male, and nymph of *E. barberi* from those of other species are: FEMALE: Usual apical setae largest on dorsal shield; many dorsal setae barbed; six pairs of dorsal pores; anterior pair of sternal setae barbed; anterior pair of sternal pores angled posteriorly; genitoventral shield widely expanded posteriorly; with over 100 accessory setae; anal shield with three usual anal setae and five smaller accessory setae; posterior usual anal seta largest on shield and barbed; about 12 multiple fimbriae on each lateral margin of epistome; each chela with two teeth; fixed chela with a bifid tip; all maxillary setae barbed; almost all setae on legs barbed. MALE: Setation of dorsal and ventral surfaces as in female; ventral shield widely expanded posterior to coxae IV and curved anteriorly lateral to coxae IV; anal region distinct; epistome as in female; structure of chelae distinct; all maxillary setae barbed; maxillary corniculi blunt; conspicuously stout ventral setae present on leg II as follows: Femur two, genu one, tibia one, tarsus two. NYMPH: Setation and mouth parts as in female.

Ewing (1925) described *E. barberi* as differing from *microti* only in having the outline of the epistome oval in *barberi* and not in *microti* and the marginal teeth of the epistome large and branched in *microti* and small and single in *barberi*. Results of examination of type material and of specimens from a variety of hosts in Maryland indicate that these species are synonymous and that on the basis of page priority *barberi* is the valid specific name. Outline of epistome and number of simple and multiple fimbriae on epistome may vary slightly among individual specimens, but not sufficiently or consistently enough to indicate a species distinction on that basis.

*Size.*—Thirty-two female specimens examined varied in length from  $952\mu$  to  $1,092\mu$ ; mean was  $1,025\mu$ . It was possible to obtain accurate measurements of body width in only 12 specimens; in these it varied from  $588\mu$  to  $644\mu$ . Ewing gives the length of one of the type females as  $1,050\mu$ ; its width as  $720\mu$ .

*Distribution and hosts.*—Ewing's type material of *barberi* was taken on the Maryland shore of the Potomac River near Plummers Island; type material of *microti* was from Bronxville, N. Y. Additional specimens in the U. S. National Museum collection were taken only from the eastern United States and southeastern Canada. I have examined specimens from the following hosts: *Pitymys pinetorum*, Point Abino, Welland County, Ontario, September 16, 1945. "Pine mouse," Willow Groove, Del., June 23, 1939; Petersburg, Va., April 1933;



College Park, Md., April 13 and 14, 1932, May 9, 1929, June 14, 1933; Chevy Chase, Md., June 7, 1932; Cabin John, Md., June 2, 1932; Burnt Mills, Md., March 24 and 29, 1932. "Albemarle meadow mouse," Petersburg, Va., April 6, 1933. "Meadow mouse," Somerset, Md., January 27, 1934. "Mouse nest," Great Falls, Va., December 26, 1926. "Short-tailed shrew," Riverdale, Md., May 27, 1934.

*Types*.—Two females (U.S.N.M. No. 950), from "nest of small mammal" from Maryland shore of Potomac River, near Plummers Island.

**EUHAEMOGAMASUS QUADRISETATUS (Vitzthum)**

FIGURE 55, *b, c*

*Haemogamasus quadrisetatus* VITZTHUM, Treubia, vol. 8, pp. 52–56, figs. 35–36, 1926; Zool. Jahrb. (Abt. Syst.), vol. 60, p. 400, 1931.

No specimens of this mite were available for study. The following data are taken from Vitzthum's paper.

*Female*.—Dorsal shield leaves much of posterior portion of dorsal surface unprotected. Almost all setae of entire animal barbed, but some on dorsal shield may be smooth. Dorsal body setae are larger at posterior body margin, where four of them are outstanding in length, being almost half as long as body of mite. Tritosternum barbed. Presternal area not mentioned or figured clearly. Sternal shield rectangular, with a nearly straight posterior margin; no indication is given whether sternal setae are barbed or smooth. Genito-ventral shield flask-shaped, with the usual pair of genitoventral setae and about 30 accessory setae. About five accessory setae on anal shield. Peritreme not figured clearly. Endopodal shields not figured clearly. Metapodal shields small and in usual position. Metasternal setae about as large as those on sternal shield. Ventral body setae not so numerous as those on dorsal surface and larger than the latter. Fixed chela distally bent like a pointed hook; with a spoonlike excavation and a tiny tooth, which may actually be a pilus dentilis. Legs are not figured, but Vitzthum reports that the only smooth setae on them are those on tarsus I and on distal ends of other tarsi.

*Size*.—Length of female is given as 1,130 $\mu$ .

*Remarks*.—Distinctive features seem to be: Almost all setae barbed; two pairs of greatly enlarged posterior body setae, each of these almost half as long as body; sternal shield with an almost straight posterior margin; genitoventral shield with about straight posterior margin; genitoventral shield with about 30 accessory setae; anal shield with 5 or 6 accessory setae; chelae toothless.

*Distribution and host*.—Taken only from *Mus lepturus*, Java.

*Male and nymph*.—Unknown.



FIGURE 52.—*Euhaemogamasus liponyssoides occidentalis*, new subspecies: *a*, Ventral view of female; *b*, ventral view of male; *c*, sternal shield of intermediate female from Lake County, Oreg.; *d*, ventral shield of nymph; *e*, genitoventral shield of intermediate female from Lake County, Oreg.; *f*, epistome of intermediate female from Lake County, Oreg.; *g*, epistome of female; *h*, chelicera of male; *i*, chelicera of female; *j*, anal shield of nymph; *k*, ventrolateral view of leg II of male.

## EUHAEMOGAMASUS LIPONYSSOIDES OCCIDENTALIS, new subspecies

FIGURE 52

*Female*.—Dorsal shield sculptured; may be broader than in *liponyssoides*. Usual pair of apical setae little, if any, longer than other setae of apical region and only slightly larger than many setae of remainder of shield. Setae over entire shield posterior to apical region  $9\mu$  to  $46\mu$  apart and of two types: the smaller about  $45\mu$  in length, the larger about  $80\mu$  long; the smaller ones are more numerous; all setae are smooth. Setae of unprotected dorsal integument about same length as larger setae of shield, longest at posterior body margin; all are smooth. Lacinae of tritosternum barbed. Presternal area with faint indications of spines on sutures. Sternal shield differs from that of *liponyssoides* in having its posterior margin nearly straight rather than invaginated. Genitoventral shield with more numerous accessory setae than in *liponyssoides*; these varied in number from 28 to 35 in a series of 13 specimens; mean was 32. One distorted specimen, not included in the above series, seems to possess about 45 accessory setae. Anterior margin of anal shield nearly straight in some specimens; setation of shield as in *liponyssoides*, with three usual anal setae and seven accessory setae. Endopodal shields distinct. Metapodal shields as in *liponyssoides*. Metasternal setae about as large as posterior pair of sternal setae. Setae of ventral integument slightly farther apart than those of dorsal shield and, like them, of two types; in general they are larger than setae of the dorsal shield and are largest at posterior and lateral margins of body; one larger pair flanks a bare spot posterior to the anal shield; all are smooth. Posterior end of peritreme does not seem to be fused with coxal fovea; tubular portion of peritreme extends to level of posterior third of coxae II. Epistome not pointed as in *liponyssoides*; almost all fimbriae distal in position and not numbering more than 10 or 12. Lateral margins of epistome nearly parallel. Chelicerae as in *liponyssoides* except that fixed chela possesses a distal seta as well as a proximal one. Maxillary and palpal setae smooth. Length-width ratios of tarsi of legs are: Leg I 5:1, leg II 4:1, leg III 4:1, leg IV 8:1. All setae are smooth.

*Male*.—Setae of dorsal shield more nearly uniform in size than in female; tritosternum and presternal area as in female, although spines on presternal sutures may be more distinct than in the female. Setation of ventral shield as in female; usual sternal setae not on lateral margins of shield; shape of shield as in *liponyssoides*. Endopodal and metapodal shields incorporated in ventral shield. Peritreme and epistome as in female. Ventral body setae as in female. Chelicerae differ from those of female in having fixed chela distinctly shorter than movable chela, relatively thicker, and bearing only a very tiny distal seta. Movable chela rodlike with a slightly curved distal end

and a truncated tip; this chela is surrounded by an irregular bursa. Maxillae and palpi as in female. Setation of legs as in female except that on leg II femur, genu, tibia, and tarsus each bear a conspicuously stout, ventral seta. Length-width ratios of tarsi as in female.

*Nymph.*—Setae of dorsal shield less numerous than in adults; nearly uniform in size in most specimens; all are smooth. Tritosternum and presternal area as in female. Ventral shield as in *liponyssoides* except that posterior end may be more distinctly set off from remainder of shield. As in female, accessory genitoventral setae are present immediately posterior to usual genitoventral setae. A pair of pores on lateral margins of shield between metasternal and posterior pair of sternal setae. Anal shield with only the three usual anal setae and three most anterior accessory setae; shield may be narrower than in the nymph of *lipondyssoides*; anterior margin of shield rounded. Endopodal shields very slender. Peritreme not well chitinized. Epistome and chelicerae as in adult female. Maxillae as in adults. Palpi may be relatively thicker than in adults. Setation of legs as in female.

*Size.*—Most females available for study were distorted so that accurate measurements were impossible to obtain. In six specimens body length varied from  $1,036\mu$  to  $1,400\mu$ ; body width from  $574\mu$  to  $798\mu$ . Mean length was  $1,171\mu$ ; mean width  $730\mu$ . In six measurable male specimens body length varied from  $952\mu$  to  $1,050\mu$ , body width from  $546\mu$  to  $588\mu$ . Six measurable nymphs varied in length from  $677\mu$  to  $826\mu$ . It was possible to obtain only two accurate measurements of body width. One specimen,  $826\mu$  long, was  $420\mu$  wide; the other was  $742\mu$  long and  $432\mu$  wide. The latter specimen may have been slightly distorted.

*Remarks.*—Distinctive characteristics of this subspecies that serve to distinguish female, male, and nymph from those of *liponyssoides* are: FEMALE: Usual pair of apical setae of dorsal shield little if any larger than other setae of apical region; large and small setae interspersed on dorsal shields; lacinae of tritosternum barbed; spines on presternal sutures indistinct; posterior margin of sternal shield nearly straight; genitoventral shield with 28 to 35 accessory setae; anterior margin of anal shield nearly straight; almost all fimbriae of epistome distal in position and not totaling more than 10 or 12 fixed chela with a distal seta as well as a proximal one. MALE: Setae of dorsal shield more nearly uniform in size than those of female; as in female, usual setae little if any larger than other setae of apical region; ventral setation and epistome as in female; fixed chela distinctly shorter and thicker than in female and with a tiny distal seta; movable chela rodlike with a truncated tip and surrounded by an irregular bursa. NYMPH: Some indication of two types of setae on dorsal shield; ac-



cessory setae immediately posterior to usual genitoventral setae; epistome as in adult female; chelicerae as in female.

Measurements indicated that male, female, and nymph of this form are larger than those of *liponyssoides*.

*Distribution and hosts*.—All specimens of *occidentalis* have been taken from northwestern United States and southwestern Canada. Records: *Mustela saturata*, Linton, Oreg., May 22, 1933. *Scapanus townsendii*, Olympia, Wash., June 25, 1934; Wilsonville, Oreg., May 10, 1938; Lake County, Oreg., November 7, 1934; Clackamas County, Oreg., May 30, 1932; Castle Rock, Wash., March 30, 1927. *Scapanus orarius schefferi*, Vancouver, British Columbia, March 29, 1938. *Scapanus orarius*, Olympia, Wash., August 16, 1926. *Neürotrichus* sp., Netarts, Oreg., March 24, 1930; Portland, Oreg., June 23, 1933. Nest of *Microtus townsendii*, Portland, Oreg., June 23, 1933. *Microtus townsendii*, Portland, Oreg., Dec. 6, 1931. *Sorex trowbridgii*, Calaveras Dam, Alameda County, Calif., April 15, 1945. *Thomomys fuscus*, Colfax, Wash., April 14, 1927. *Blarina brevicauda talpoides*, Morgan, Utah, August 31 and September 8, 1931.

*Type*.—A female (U. S. N. M. No. 1886) taken from nest of *Microtus townsendii* at Portland, Oreg., on December 24, 1931, by S. G. Jewett, Jr.

*Paratypes*.—A male on slide with type, two females, one male, two nymphs, from *Scapanus townsendii*, Wilsonville, Oreg., May 10, 1938, H. H. Stage, Bish. No. 17174; three females, one nymph, from *Scapanus townsendii*; Lake County, Oreg., November 7, 1934, H. H. Stage, Bish. No. 17075; two nymphs, from *Scapanus townsendii*; Castle Rock, Wash., March 30, 1927, Leo K. Couch; one male, from *Thomomys fuscus*, Colfax, Wash., April 14, 1927, Leo K. Couch.

*Discussion*.—The three paratype females and single nymph from *Scapanus townsendii*, Lake County, Oreg., exhibit some characteristics that seem to be intermediate between *liponyssoides* and *occidentalis*. Distinctive features of these specimens are: Dorsal shield relatively narrower than in other specimens of *occidentalis*; setae on shield of nearly uniform size. Sternal shield intermediate in outline between *liponyssoides* and *occidentalis* in that its posterior margin is invaginated to a level slightly anterior to posterior pair of sternal setae; distance between middle pair of setae and anterior and posterior pairs about equal. Genitoventral shield relatively narrower than in either *liponyssoides* or *occidentalis* and with fewer accessory setae: 10, 13, and 13 on the three females on the slide. Anal shield may be relatively shorter than in *liponyssoides* or *occidentalis*; posterior pair of accessory setae only slightly anterior to anus. Ventral body setae slightly smaller than those of dorsal shield. Shape of posterior end of peritreme distinctive. Epistome with five to eight lateral fimbriae on each side.

## ISCHYROPODA, new genus

Sternal shield with accessory setae; at least leg II conspicuously stout and with spurs and massive, often blunt, setae especially on tarsus; anal shield of male separate; accessory setae present on ventral shield of nymph.

Genotype: *Ischyropoda spiniger*, new species.

## KEY TO FEMALES OF ISCHYROPODA

1. Movable chela toothless; all setae on dorsal shield smooth; leg I with a stout, posteriorly directed coxal spur; genu of leg II with a similar spur. spiniger, new species.
- Both chelae with teeth----- 2
2. Many setae on dorsal shield barbed; coxa I and genu II without spurs. armatus, new species.

## ISCHYROPODA SPINIGER, new species

## FIGURE 53

*Female*.—Body broad but distinctly pointed anteriorly. Dorsal shield relatively short, with a blunt, slightly indented posterior margin; much of dorsal surface unprotected. Usual pair of apical setae situated immediately anterior to shield, smooth and shorter than setae on the shield, and flanked by a pair of smaller setae; all setae of shield smooth,  $30\mu$  to  $40\mu$  apart, and relatively large, being  $80\mu$  to  $120\mu$  in length. Shield sculptured. Setae of unprotected dorsal integument smooth and those on the posterior body margin longer and slenderer than those on the shield. Tritosternum barbed. Presternal area sculptured but sutures lack spines. Sternal shield not clearly outlined, its lateral and posterior margins somewhat irregular; usual sternal setae smooth and larger than accessory setae, which number 28, 27, and 23 in specimens available for study and are scattered over the shield in no apparent pattern; these are of various sizes but are larger near margins of the shield; none are present on the anterior margin of the shield; all are smooth. Anterior pair of sternal pores nearly parallel with anterior margin of shield; lateral end of posterior pair of pores in contact with lateral margins of shield; shield sculptured. Genitoventral shield relatively narrow, about three and one-half times as long as wide and with nearly parallel lateral margins and an irregularly rounded, almost truncate posterior margin; possesses usual pair of genitoventral setae and several almost equally as large accessory setae; these numbered 6, 7, and 8 in the three females examined. Anal shield of distinctive shape, with nearly lateral margins and only very roughly triangular; three usual anal setae present, all much smaller than adjacent ventral body setae; the posterior unpaired seta nearer to the anus than to the posterior margin of the shield and not quite half as large as the paired setae. Endopodal shields very slender. Metapodal shields small and oval; in addi-

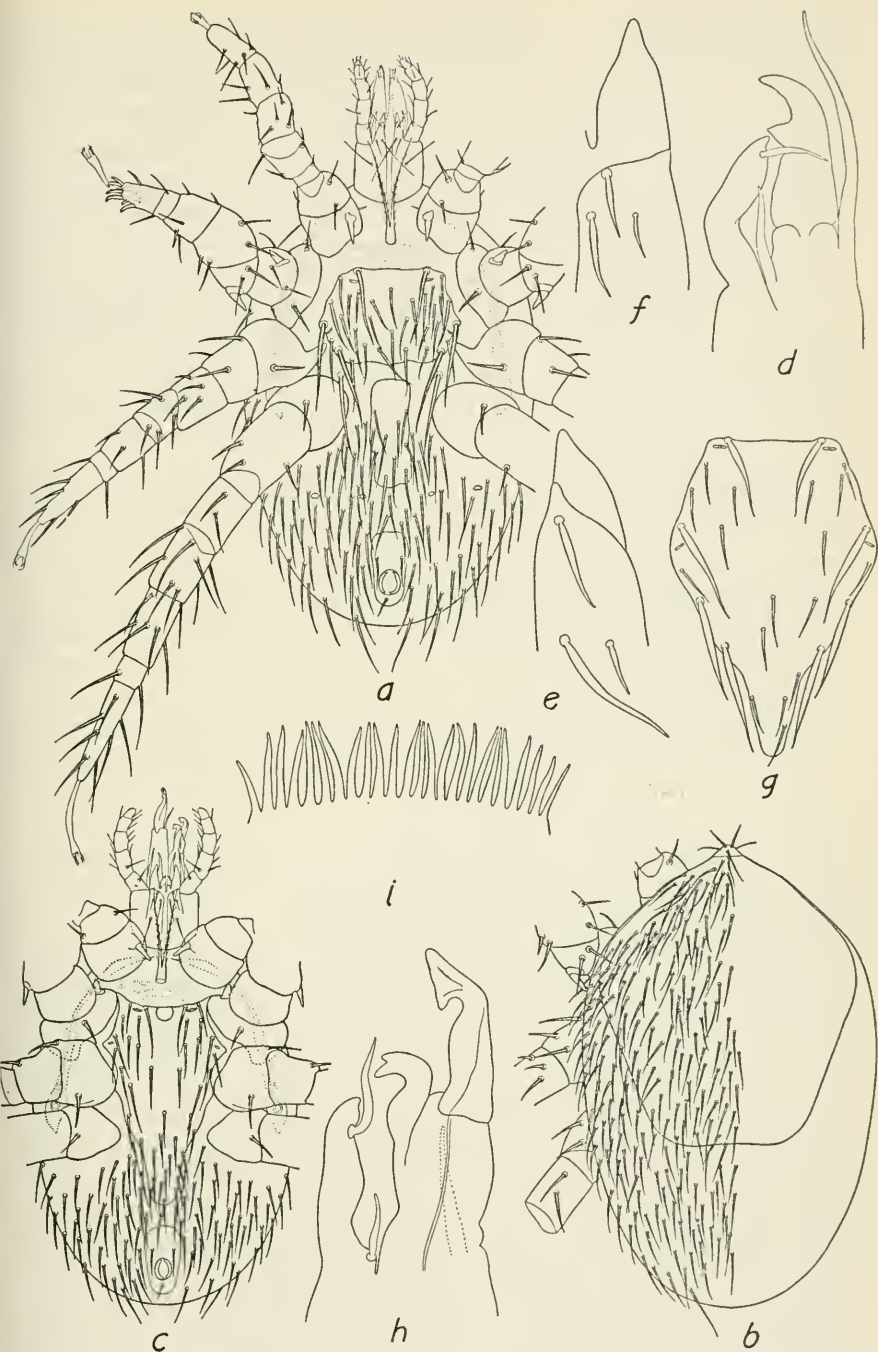


FIGURE 53.—*Ischyropoda spiniger*, new species: *a*, Ventral view of female; *b*, dorsal view of female; *c*, ventral view of male; *d*, chelicera of female; *e*, cornicula of female; *f*, cornicula of male; *g*, ventral shield of nymph; *h*, chelicera of male; *i*, epistome of female.

tion to those posterior to coxae IV there may be three or four slightly bent shields adjacent to lateral and posterior margins of genitoventral shield. Metasternal setae at least as large as posterior pair of usual sternal setae. Ventral body setae like those on dorsal surface. Peritreme slender, details of its structure not clear. Anterior margin of epistome nearly straight or forming a gentle arc; about 25 or 30 fimbriae. Fixed chela with a curved, pointed tip and one tooth; a large seta arises near its distal end and extends beyond its tip. Movable chela toothless, rodlike, with a distal seta as well as a proximal one. Maxillary setae relatively small, especially the lateral member of the middle pair; all are smooth. Largest setae on palpi are those on ventral surfaces of coxa and trochanter. Legs relatively stout, their setation distinct. Leg IV largest; others about equal in length. Distinctive features of each pair of legs are as follows: **LEG I**: Length-width ratio of tarsus 3:1, a large, posteriorly directed spur on ventral surface of coxa. **LEG II**: Stout to the point of distortion; femur and genu are outstanding in this respect; length-width ratio of tarsus 2.5:1, coxa with a large, straight, ventral spur and another on its anterodistal margin; femur with a large, slightly bent spur on its posterior aspect; because of distortion femur appears wedge shaped dorsally; genu is also greatly thickened, this overdevelopment causing the leg to appear twisted; genu with three or four spurlike setae posteriorly; tibia with two large spurlike setae posteriorly; tarsus with six or seven ventral spurs, most of which are slightly bent distally and possess blunt, rounded tips. **LEG III**: Length-width ratio of tarsus 4.5:1; most ventral setae large and with blunt, rounded tips. **LEG IV**: Length-width ratio of tarsus 6:1; a stout, ventral spur on anterodistal margin of coxa; ventral setae on all segments large; all setae smooth; setae on dorsal surfaces slenderer.

*Male*.—Body shape, dorsal shield, setae of unprotected dorsal surface, tritosternum, and presternal area as in female. Ventral shield covers an area that apparently corresponds to sternal and genitoventral regions of female. It is narrower posterior to coxae IV and tapers to a bluntly rounded end immediately anterior to the anal shield; setation of ventral surface differs from that of female in having no accessory setae on central portion of the shield and in having all accessory setae in sternal area of about equal size; there are no accessory setae on lateral margins of shield in sternal region; posterior pair of sternal pores do not touch lateral margins of shield. Setae in genitoventral region may be more numerous than in female. Anal shield as in female. Endopodal shields incorporated in ventral shield. Metapodal shields not seen. Metasternal setae on ventral shield. Ventral body setae as in female. Peritreme not clear. Epistome as in female. Chelae show sexual dimorphism; exact relationship of structures present to those of female not clear. Fixed chela toothless; with



two setae, one distal and one proximal. Anterior single and middle paired maxillary setae relatively closer than in female. Palpi and legs as in female.

*Nymph.*—Dorsal shield, dorsal and ventral body setae, tritosternum, and presternal area as in adult. Setation of ventral shield as in male in that accessory setae, which number about 20, are not present in central portion of shield or on its lateral margins. Anal shield as in adults. Endopodal and metapodal shields not seen. Peritreme not clear. Epistome as in adults. Chelicerae as in adult female. Palpi and legs as in adults, may be even relatively shorter.

*Size.*—Three female specimens measured  $1,550\mu$ ,  $1,540\mu$ , and  $1,375\mu$  in body length. The same specimens measured  $900\mu$ ,  $950\mu$ , and  $850\mu$  in width. The only male measured  $1,175\mu$  in length and  $750\mu$  in width. Two nymphs were  $1,050\mu$  and  $955\mu$  long and  $650\mu$  and  $625\mu$  wide.

*Distribution and hosts.*—Has been taken only from Dos Palmos, Calif., on *Perognathus penicillatus angustirostris*, March 23, 1934; *Perognathus spinatus*, March 1934; and *Perognathus* sp., March 25, 1934.

*Type.*—A female (U. S. N. M. No. 1887) taken on *Perognathus penicillatus angustirostris* at Dos Palmos, Calif., March 23, 1934, by H. S. Gentry.

*Paratypes.*—A male on slide with type, one female, two nymphs, Dos Palmos, Calif., from *Perognathus spinatus*, March 1934, H. S. Gentry.

#### ISCHYROPODA ARMATUS, new species

##### FIGURE 54

*Female.*—Dorsal shield rounded posteriorly not covering entire dorsal surface. Usual pair of apical setae smooth and flanked by a pair of larger, barbed setae. Most setae of dorsal shield  $20\mu$  to  $40\mu$  apart and about  $40\mu$  in length; those in central portion may be closer together; most setae on shield nearly as large as usual apical setae; some at margins larger; some, particularly at margins, barbed. Dorsal body setae equal in size to marginal setae of shield; many are barbed. Tritosternum barbed. Presternal area sculptured; spines on all sutures. Sternal shield rectangular, with rounded corners and a slightly invaginated posterior margin; in addition to the three pairs of usual sternal setae there are several large accessory setae, which varied in number from 5 to 10 (means 7) in a series of 23 females; these are about two-thirds as large as the usual sternal setae and like them are smooth. Bases of usual setae embossed; sternal pores relatively long and curved; centrally located accessory setae slightly smaller than those more lateral in position. Genitoventral shield bulbous posteriorly and not reduced in size; only setae on anterior half of shield are usual pair of genitoventral setae; accessory setae are smaller and

varied in number from 19 to 28 in a series of 15 specimens; mean was 24. Anal shield with three usual anal setae and two larger accessory setae; posterior usual seta smallest on shield; all setae smooth; usual setae

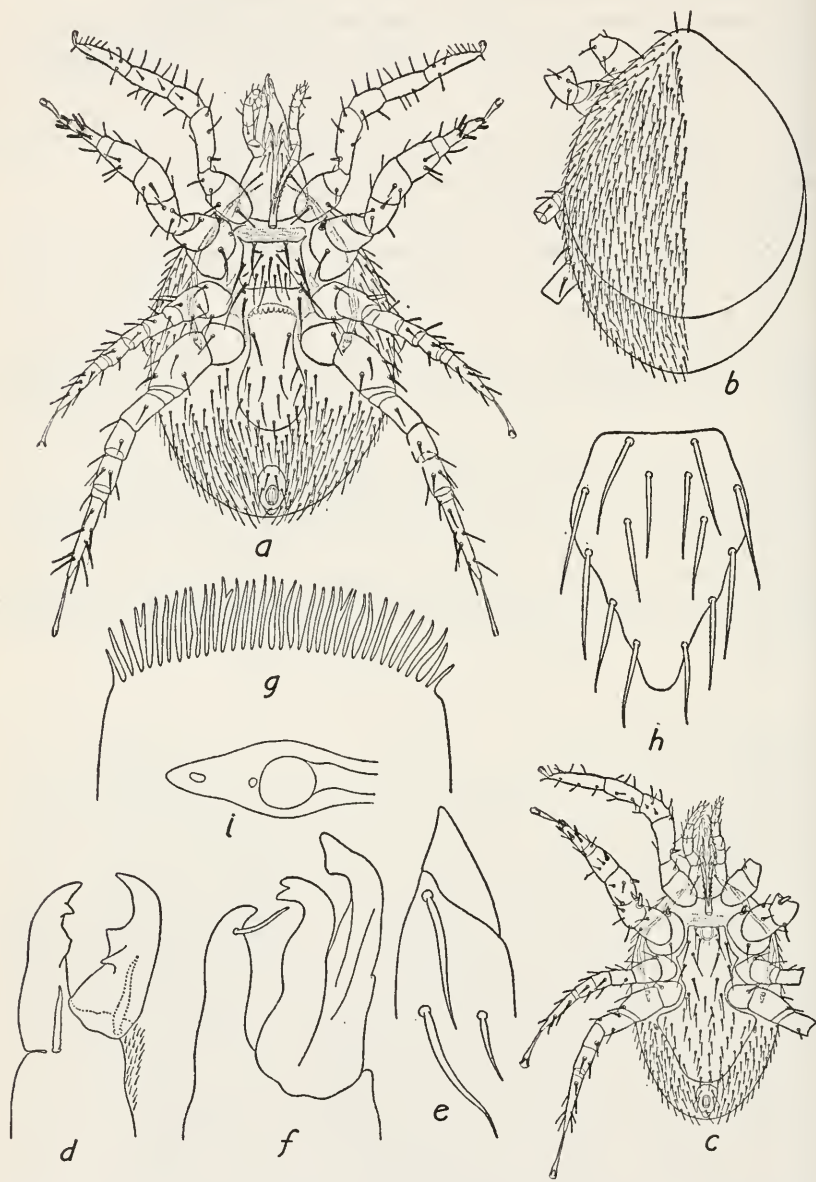


FIGURE 54.—*Ischyropoda armatus*, new species: *a*, Ventral view of female; *b*, dorsal view of female; *c*, ventral view of male; *d*, chelicera of female; *e*, cornicula of female; *f*, chelicera of male; *g*, epistome of female; *h*, ventral shield of nymph; *i*, posterior end of peritreme of female.

smaller than adjacent ventral body setae; two faint prominences on anterior margin of shield; postanal seta closer to cribriform area than to anus. Endopodal shields well developed. Metapodal shields small and irregular in outline. A small, oval pore immediately anterior to each metasternal seta. Ventral body setae slightly smaller than those of dorsal shield, some barbed, largest at posterior body margin. Posterior end of peritreme blunt and not joined to coxal fovea. Epistome with a nearly straight or gently curved anterior margin and with about 30 fimbriae, some branched. Fixed chela nearly straight, with two teeth and a gently curved tip; a proximal seta present. Movable chela also with two teeth; distinctive in having tip bent at a right angle; a large seta and a fringe of small setae at base of chela. Maxillary setae smooth; as in *spiniger* the lateral member of the middle pair is smallest. All palpal setae smooth. Legs relatively longer and slenderer than in *spiniger*; dorsal setae of legs relatively small and slender; ventral setae stout, spurlike. Distinctive features of each leg are: **LEG I**: Tarsus distinctive in tapering gradually toward its distal end rather than being nearly cylindrical throughout its length; length-width ratio of tarsus 6:1. **LEG II**: Relatively thicker than others; a stout spur on anterodistal margin of coxa; two spurlike ventral setae on tibia and five or six on tarsus; some, but not all, blunt-tipped as in *spiniger*; length-width ratio of tarsus 4:1. **LEG III**: Trochanter with two, tarsus with six or seven large, ventral spurlike setae; length-width ratio of tarsus 6:1. **LEG IV**: Trochanter, femur, genu, and tibia each with one or two spurlike setae; tarsus with six or seven ventral spurlike setae; length-width ratio of tarsus 8:1:

*Male*.—Dorsal shield covering nearly entire dorsal surface; setae may be more numerous and relatively smaller than on female. Dorsal body setae as in female but sometimes slightly smaller. Tritosternum and presternal area as in female. Ventral shield expanded posteriorly nearly to lateral margins of coxae IV; setation differing from that of female in having only two pairs of accessory setae present anterior to coxae IV. Anal shield as in female. Metapodal shields distinct; adjacent to or in contact with lateral margins of ventral shield. Ventral body setae, peritreme, and epistome as in female. Chelae much like those of the male of *spiniger*, exact details of structure are impossible to determine in specimens available for study. Palpi as in female. Legs differ from those of female in following respects: Femur of leg I with a stout ventral spur near its proximal margin; femur of leg II with two large, blunt, ventral spurs; trochanter of leg III with distal margin prolonged into a spur; trochanter of leg IV with two large spurs, one of which is blunt.

*Nymph*.—Relatively shorter than adults; dorsal shield, dorsal body setae, tritosternum, and presternal area as in female. Only two pairs

of accessory setae on ventral shield. Anal shield as in adults but lacking accessory setae. Endopodal shields slenderer than in female. Ventral body setae as in female. Metapodal shields more oval than in adults. Peritreme not well developed. Epistome as in adults. Chelae, maxillae, palpi, and legs as in female.

*Size*.—In 15 measurable female specimens, body length varied from 925  $\mu$  to 1,225  $\mu$ ; body width from 450  $\mu$  to 760  $\mu$ ; mean length was 1,047 $\mu$ ; mean width 657 $\mu$ . Three male specimens measured 840 $\mu$ , 850 $\mu$ , and 875  $\mu$  in length; body width in each of these specimens was 500  $\mu$ . Three nymphs measured 800  $\mu$  in body length; one of these measured 485  $\mu$  in width; another was 500  $\mu$  in width; one specimen was 850 $\mu$  in length.

This species differs from *I. spiniger* in many respects, of which the following are outstanding: **FEMALE**: Many of dorsal setae barbed; sutures of presternal area with spines; less than half as many accessory sternal setae as *spiniger*; sternal shield rectangular with rounded corners; genitoventral shield flask-shaped; with over twice as many accessory setae as *spiniger*; anal shield with only two accessory setae; both chelae with teeth; legs slenderer than in *spiniger* and lacking heavy spur on coxa of leg I and coxa and femur of leg II; tarsus I slender, tapering gradually toward distal end; most setae of legs small and slender. **MALE**: Dorsal shield covers nearly entire dorsal surface; ventral shield expanded posterior to coxae IV; with only two pairs of accessory setae anterior to coxae IV; special setation of legs. **NYMPH**: Setation and chelae as in female; only two pairs of accessory setae on ventral shield.

*Distribution and hosts*.—This species has been taken from Arizona, California, Colorado, and New Mexico on the following: *Thomomys bottae*, Colorado Desert, Calif., February 17, 1934; *Thomomys* sp., Lincoln County, N. Mex., July 16 and 19, 1947; *Dipodomys merriami merriami*, Westmorland, Calif., July 21, 1933; *Dipodomys deserti deserti*, Westmorland, Calif., July 21, 1933; *Dipodomys merriami simiolus*, Dos Palmos, Calif., March 1934; *Peromyscus maniculatus rufinus*, Mogollon Mountains, N. Mex., August 30, 1933; *Peromyscus* sp., Monterey, Calif., December 30, 1948 (Bureau of Vector Control collection, California Department of Public Health); *Neotoma albigula*, Santa Rita Mountains, Ariz., May 18, 1939; *Perognathus* sp., Monterey, Calif., October 21, 1940; *Perognathus californicus*, Monterey, Calif., July 9, 1939; *Perognathus inornatus*, Kern County, Calif., March 26, 1930; *Perognathus xanthonotus*, Kern County, Calif., April 19, 1930; *Onychomys leucogaster arcticeps*, Logan County, Colo., September 30, 1926; *Citellus burrow*, Davis, Calif., August 12, 1948; "spiny pocket mouse," Pasadena, Calif., April 4, 1933 (Bureau of Vector Control collection, California Department of Public Health).



*Type*.—A female (U. S. N. M. No. 1888) taken on *Thomomys bottae*, Colorado Desert, Calif., February 17, 1934, by H. S. Gentry.

*Paratypes*.—Three females, one nymph, from *Dipodomys merriami merriami*, Westmorland, Calif., July 21, 1933, collected by H. S. Gentry; two nymphs from *Dipodomys merriami simiolus*, Dos Palms, Calif., March 1934, collected by H. S. Gentry; one male from *Neotoma albigula*, Santa Rita Mountains, Ariz., May 18, 1939, collected by C. A. Flock.

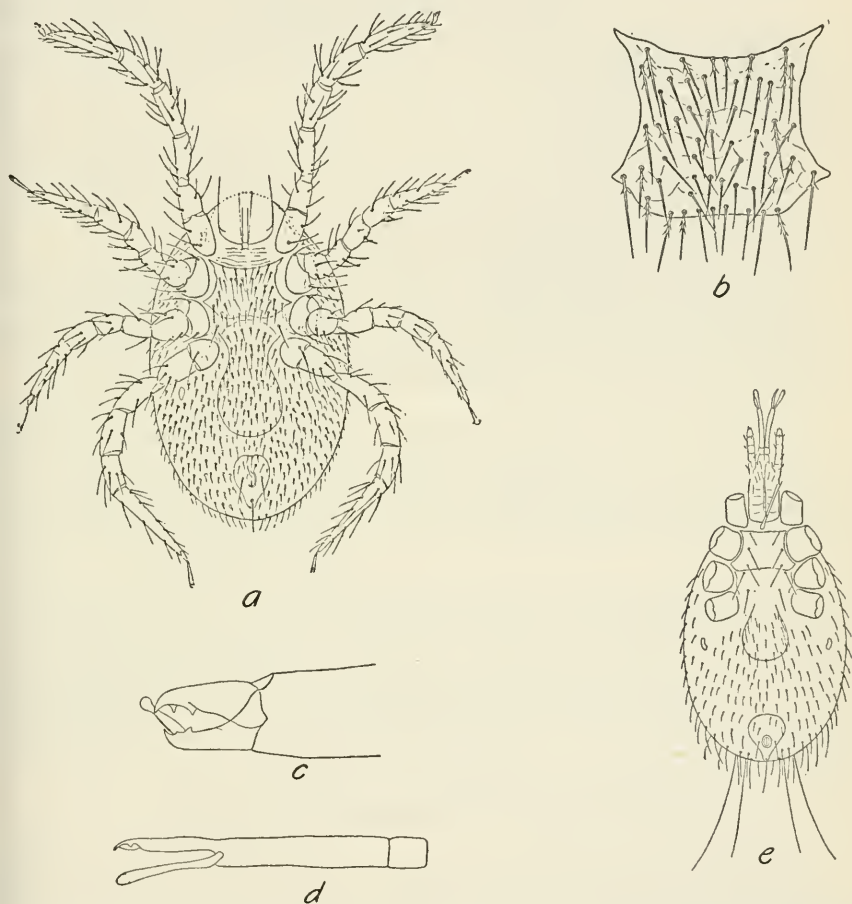


FIGURE 55.—*a-c*, *Haemogamasus liberiensis* Hirst (after Hirst): *a*, Ventral view of female; *b*, sternal plate of female; *c*, chelicera of female. *d, e*, *Euhaemogamasus quadrisetatus* (Vitzthum) (after Vitzthum): *d*, Chelicera of female; *e*, ventral view of female.

## KEY TO NYMPHS OF HAEMOGAMASINAE

1. Ventral shield with accessory setae..... 9  
    Ventral shield without accessory setae..... 2
2. Chelae toothless; all setae smooth..... 3  
    Chelae with teeth; with some barbed setae..... 5
3. Length-width ratio of tarsus II not over 3:1—*H. harperi*, new species (p. 223)  
    Length-width ratio of tarsus II 4: 1 or greater..... 4
4. Accessory anal setae larger than usual setae; usual pair of apical setae  
    little if any larger than other setae of apical region.  
        *E. liponyssoides occidentalis*, new subspecies (p. 255)  
    Accessory anal setae smaller than usual setae; usual pair of apical setae  
    distinctly largest on shield..... *E. liponyssoides* (Ewing) (p. 244)
5. Fixed chela with 2 teeth..... 6  
    Fixed chela with 1 tooth..... 8
6. Genitoventral setae on ventral shield; all maxillary setae smooth; no  
    barbed setae on legs..... *E. horridus* (Michael) (p. 235)  
    Genitoventral setae not on ventral shield; at least 3 pairs of maxillary  
    setae barbed; many barbed setae on legs..... 7
7. All maxillary setae barbed; anterior pair of sternal pores not parallel with  
    with anterior margin of shield..... *E. barberi* (Ewing) (p. 249)  
    Anterior pair of maxillary setae smooth; anterior pair of sternal pores  
    parallel with anterior margin of shield..... *H. alaskensis* (Ewing) (p. 213)
8. Base of almost every dorsal body seta with a posteriorly directed thornlike  
    process; anterior pair of maxillary setae smooth.  
        *E. oudemansi* (Hirst) (p. 240)  
    No dorsal body seta with a posteriorly directed, thornlike basal process;  
    anterior pair of maxillary setae barbed..... *E. ambulans* (Thorell) (p. 228)
9. Coxa I with a large, posteriorly directed ventral spur; genu II with a  
    similar spur; movable chela toothless..... *I. spiniger*, new species (p. 258)  
    Coxa I and genu II without spurs; movable chela with 2 teeth  
        *I. armatus*, new species (p. 261)

Nymphal specimens of *H. avisugus*, *H. liberiensis*, *H. mandschuricus*, and *E. quadrisetatus* have never been found. Although the nymph of *H. hirsutus* was said by Oudemans (1913) to resemble the adult female in several respects, specific information is lacking, and, as no specimens were available for study, the nymph of this species was omitted from the preceding key.

## KEY TO MALES OF HAEMOGAMASINAE

1. With a separate anal shield..... 10  
    Anal region incorporated in ventral shield..... 2
2. All setae smooth..... 3  
    With some barbed setae..... 6
3. Accessory sternal setae present; movable chela bifurcate.  
        *H. hirsutus* Berlese (p. 210)  
    Accessory sternal setae absent; movable chela undivided..... 4
4. Second pair of sternal setae on lateral margins of shield; anal region dis-  
    tinct from remainder of shield..... *H. harperi*, new species (p. 223)  
    Second pair of sternal setae not on lateral margins of shield; anal region  
    not distinct from remainder of shield..... 5

5. Chelae about equal in length; usual pair of apical setae clearly largest on dorsal shield; setae of dorsal shield nearly uniform in size.  
*E. liponyssoides* (Ewing) (p. 244)  
 Fixed chela distinctly the shorter; usual pair of apical setae little if any larger than others of apical region; large and small setae interspersed on dorsal shield.....*E. l. occidentalis*, new subspecies (p. 255)
6. Fixed chela with 2 teeth.....*E. horridus* (Michael) (p. 235)  
 Fixed chela with 1 tooth.....*H. mandschuricus* Vitzthum (p. 218)  
 Fixed chela toothless..... 7
7. Anterior pair of maxillary setae smooth..... 8  
 Anterior pair of maxillary setae barbed..... 9
8. One pair of accessory setae on anterior margin of sternal shield; shorter branch of movable chela with a bifurcate tip...*H. alaskensis* Ewing (p. 218)  
 Accessory sternal setae lacking; shorter branch of movable chela undivided  
*E. oudemansi* (Hirst) (p. 240)
9. Posterior peritremal pore on medial margin of peritremal shield.  
*E. barberi* (Ewing) (p. 249)  
 Posterior peritremal pore on or near lateral margin of peritremal shield.  
*E. ambulans* (Thorell) (p. 228)
10. Coxa I and genu II each with a large ventral spur; ventral shield widest at level of coxae II.....*I. spiniger*, new species (p. 258)  
 Coxa I and genu II without spurs; ventral shield widest posterior to coxae IV.....*I. armatus*, new species (p. 261)
- Male specimens of *H. avisugus*, *H. liberiensis*, and *E. quadrisetatus* have never been found.

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## A NEW CARIBBEAN CORAL OF THE GENUS CHRYSOGORGIA

By FREDERICK M. BAYER

The cruises of the United States Fish Commission steamer *Albatross* in the western Atlantic Ocean yielded many interesting species of alcyonarian corals, many of which are still to be studied. Among these is a most unusual chrysogorgid from the Caribbean Sea, quite unlike anything previously recorded from that area, or indeed from any other.

**CHRYSOGORGIA ELISABETHAE**, new species

FIGURES 56, 57; PLATE 9

The colony is small, 65 mm. in height and 45 mm. in spread, attached by a small, white calcareous basal disk to a shell of the mollusk *Tugurium caribaeum* (Petit). The main stem of the colony makes a sudden change in direction at a point 6.5 mm. from the base, at the first branch origin; beyond this point its direction remains unchanged, giving off branches in a right-handed spiral that approximates the  $2/5$  arrangement. The branches arise at close intervals, the stem internodes being approximately 2 mm. long. The branches subdivide dichotomously as many as eight times, in various planes, so that the colony is quite bushy. The internodes of the branches are 4–5 mm. long except the distal one, which may be shorter. The main stem is about 1 mm. in diameter, the branches about 0.75 mm. in the first internode and 0.5 in the third. Each branch internode bears a single zooid, and none is present on the stem. Nematozooids appear to be lacking. The axis of the alcoholic type is brown near the base, paling

to straw yellow in the branches, where there is a greenish-golden iridescence; zooids white.

The zooids are subclavate, about 1 mm. in height by 0.65—0.75 mm. in diameter, directed distally to a slight degree. Those in the older parts of the colony have a pronounced asymmetrical basal swelling containing gonads. The body of the zooid is covered by a layer of long, sometimes flattened, rather pointed rods transversely arranged and strongly bent to conform with the curvature of the body. Many of these have on the upper or lower margin one or more pronounced lobes or spines, which project outward from the body of the zooid, giving it a decidedly spinose appearance, or imbricate with the adjacent spicules. The rods tend to be flatter distally in the zooid body, and immediately beneath the tentacles may consist of three flat, pointed lobes, the middle one lying along the tentacle back, the lateral ones conforming with the transverse spicules below. The tentacles themselves usually have proximally one or two pairs of longitudinally disposed, irregular flattened sclerites rudely *en chevron* arrangement, usually followed distally by two or three rows of longitudinally placed spicules, each row consisting of one or more long, flattened, somewhat granular rods. Beyond these, toward the tip, the small, elongate, irregular scales lie crosswise. The pinnules contain small, blunt-ended, flattened rods.

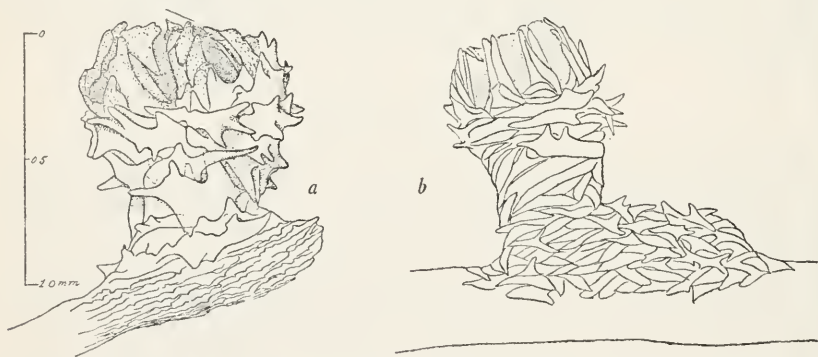


FIGURE 56.—*Chrysogorgia elisabethae*, new species: *a*, A fully developed terminal zooid from one of the lower branches; *b*, a zooid with basal swelling containing gonads, taken from one of the proximal internodes.

The coenenchyma is thin and easily rubbed off; it contains elongate spinous rods and crosses, for the most part lying lengthwise of the axis.

Some of the irregular body spicules measure as follows in maximum length and width (mm.): 0.6 by 0.25; 0.55 by 0.35; 0.55 by 0.15; 0.45 by 0.15. From the tentacle bases: 0.35 by 0.05; 0.35 by 0.06; 0.23 by 0.05. From the distal part of the tentacle: 0.18 by 0.07; 0.09 by 0.02. From the coenenchyma: 0.4 by 0.07; 0.41 by 0.08; 0.34 by 0.07.



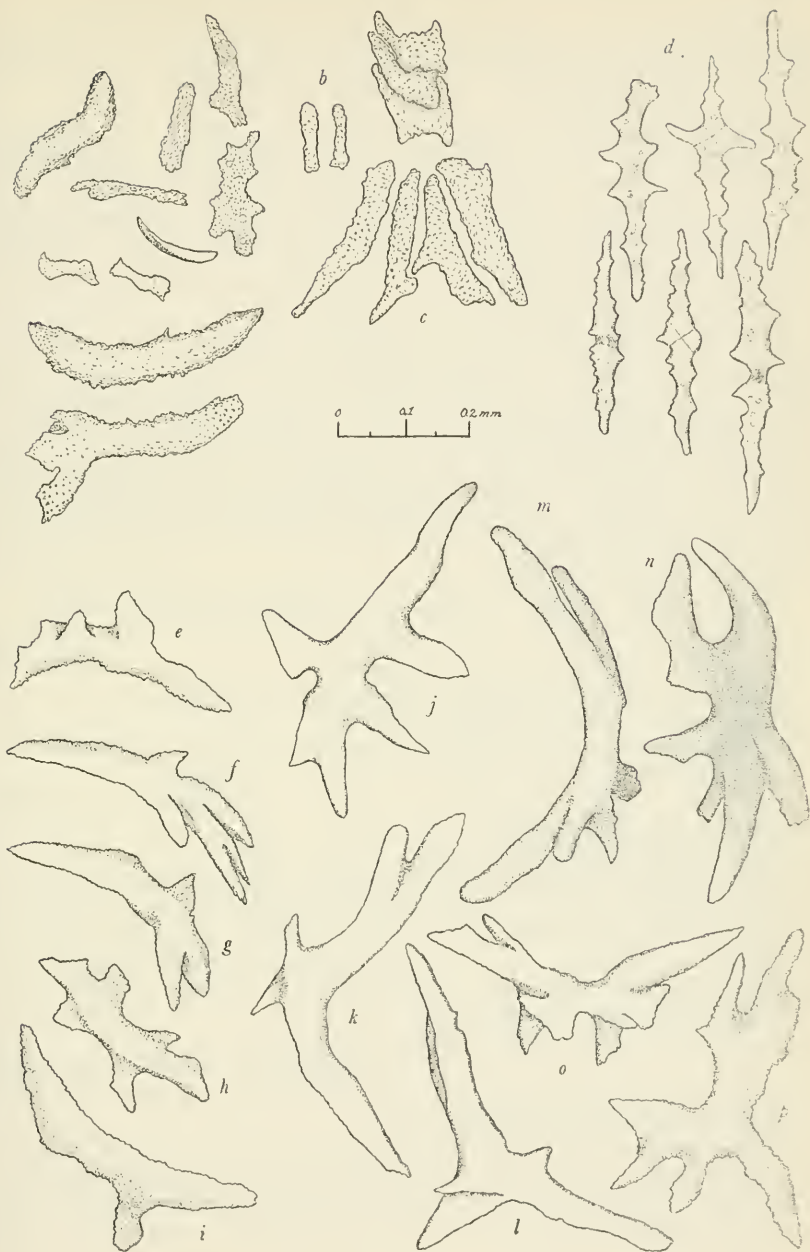


FIGURE 57.—*Chrysogorgia elisabethae*, new species: *a*, Spicules of the tentacles: large irregular spindles from the base, smaller scales from the distal end; *b*, flattish scales of the pinnules; *c*, spicules from proximal part of the tentacle separated to show arrangement; *d*, spicules of the coenenchyme; *e-i*, spiniferous rods from a young zooid; *j-p*, spiniferous and branched rods and plates from a fully developed zooid; *m, n*, two views of the same plate.

*Holotype*.—U. S. N. M. No. 7552, from station 2129, U. S. F. C. steamer *Albatross*; Caribbean Sea, south of Santiago de Cuba; lat. 19°56'04" N., long. 75°48'55" W.; 274 fathoms; blue mud and fine sand; February 27, 1884.

*Remarks*.—From the character of its spiculation, *Chrysogorgia elisabethae* appears to fall into the group *Squamosae Aberrantes* of Versluys, since the spicules are generally flattened and are, to all intents and purposes, scales. However, the spicules are probably derived from rods or spindles, as indicated by underdeveloped forms present in young zooids.

It is with much pleasure that I dedicate this new species to Dr. Elisabeth Deichmann, of the Museum of Comparative Zoology, who has contributed much to the knowledge of the Atlantic Alcyonaria.

The genus *Chrysogorgia* has been most adequately covered by Dr. Deichmann (1936, p. 227) in her monograph of the Alcyonaria of the western part of the Atlantic Ocean. The key to the species given therein is excellent, and need be altered only enough to include the new species described here.

KEY TO THE OF SPECIES OF CHRYSOGORGIA KNOWN FROM THE WESTERN ATLANTIC

- |   |  |
|---|--|
| 1. Spicules of the zooids transversely arranged.....  | 2  |
| Spicules of the zooids longitudinally arranged.....   | 6  |
| 2. Zooid spicules as pointed, curved, simple rods.....  | 3  |
| Zooid spicules as curved, sometimes flattened rods with spinelike or branchlike processes projecting outward from zooid body. |  |
|   | <i>elisabethae</i> , new species                   |
| 3. Branches rigid, bent upward.....   | 4  |
| Branches not especially rigid, almost vertically placed.....  | 5  |
| 4. Branches tend to ramify in one plane, becoming flabellate; internodes numerous, short.....                                 | <i>desbonni</i> Duchassaing and Michelotti         |
| Branches not predominately in one plane, nor flabellate; internodes few, longer.....  | <i>desbonni</i> var. <i>thyrsiformis</i> Deichmann |
| 5. Zooid spicules delicate, with small warts; coenenchyma spicules as short, simple rods, almost smooth.....                  | <i>fewkesi</i> (Verrill)                           |
| Zooid spicules stouter; coenenchyma spicules spinose.   |  |
|   | <i>fewkesi</i> var. <i>multiflora</i> Deichmann    |
| 6. Spicules as pointed or blunt spinous rods.....   | <i>elegans</i> (Verrill)                           |
| Spicules as flat, blunt ending plates.....  | 7  |
| 7. Spicules as large, flat scales; branches robust, with large zooids vertically placed.....                                  | <i>squamata</i> (Verrill)                          |
| Spicules as small, flat scales; branches delicate, hair-fine, with long zooids obliquely placed.....                          | <i>agassizii</i> (Verrill)                         |

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# REVISION OF THE NORTH AMERICAN GRASSHOPPERS OF THE CONALCAEA COMPLEX

By ASHLEY B. GURNEY

GRASSHOPPERS of the *Conalcaea* complex inhabit much of Mexico and the States of Arizona and New Mexico. They are sometimes encountered in surveys by economic entomologists, and so it is important to clarify the problems of their identification, though these species themselves are not known to be injurious to cultivated plants. The grasshoppers here treated were formerly referred to the genus *Conalcaea* alone, but an additional genus is now recognized in an attempt to explain the relationship and distinguishing features of the species more clearly than has previously been done. As now understood, the complex comprises two genera and seven species, and one species includes two subspecies. Two species are described as new. The term "complex" is used primarily for convenience, rather than as a permanent group of nomenclatorial importance, since a presentation of related genera in form like a final arrangement must await fuller reports on the Mexican forms.

Characters of the male genitalia, especially the aedeagus, which usually is concealed, have been found very useful, both as specific and generic criteria. Specimens with the aedeagus extracted and allowed to dry exposed at the end of the abdomen are useful and in certain species may give entirely adequate information on aedeagal characters. The most satisfactory preparations of the aedeagus, however, are those preserved in fluid, and for conven-

ience they may be kept in microvials of glycerol attached to the pins bearing the specimens from which they were extracted after relaxation. Study of the aedeagus has shown that material formerly referred to *Conalcaea humphreysii* (Thomas) contains two distinct species and also that United States records of *C. poecila* Hebard are in error. The considerable variability of the male cercus that occurs in *C. huachucana* Rehn was not previously recognized, and examination of large series now suggests that *C. coyoterae* Hebard, typical specimens of which seem quite distinct from *huachucana*, is in reality a subspecies of *huachucana*. Most of the diagnostic characters have been illustrated, thus permitting brief descriptions. To avoid repetition characters common to both genera treated are given only once.

James A. G. Rehn, Academy of Natural Sciences of Philadelphia; Dr. T. H. Hubbell, University of Michigan; Dr. Joseph Bequaert, Museum of Comparative Zoology; and Dr. R. H. Beamer, University of Kansas, were most cooperative in making their entire collections of these grasshoppers available for study. This material, supplementing that in the United States National Museum, has made it possible to examine all the existing<sup>1</sup> holotypes and lectotypes involved and to study the principal important series as well. The following individuals also contributed helpful specimens or field notes: Dr. Irving J. Cantrall, University of Michigan; Kenneth R. Hobbs, Pomona, Calif.; W. W. Jones, Douglas, Ariz.; Dr. E. R. Tinkham, Indio, Calif. To Mr. Rehn I am especially grateful for many helpful courtesies and for sending me numerous personal field notes. Dr. Hubbell and Dr. Cantrall generously placed at my disposal a new species, complete with notes on its distinguishing characters, which the latter had originally intended to describe. Dr. H. Radclyffe Roberts, of the Academy of Natural Sciences of Philadelphia, kindly advised me on generic relationships based on his extensive and largely unpublished studies of Mexican Melanoplinae. Finally, I am indebted to H. C. Wilcox, R. C. Bonde, and Bruce Denman, of the United States Department of Agriculture, for photographing specimens.

All the drawings are my own work.

Grasshoppers of the *Conalcaea* complex belong to the tribe Melanoplinae,<sup>2</sup> and the two genera treated have the following characters in common:

<sup>1</sup> The type of *Barytettix humphreysii* (Thomas) apparently no longer exists. Hebard (Proc. Acad. Nat. Sci. Philadelphia, vol. 79, pp. 1-11, 1927), who reviewed the types of species of Orthoptera described by Cyrus Thomas, reported that this type was missing.

<sup>2</sup> I have followed Roberts (Proc. Acad. Nat. Sci. Philadelphia, vol. 99, p. 202, 1947) in adopting the tribal name Melanoplinae instead of using the long-used group name Melanopli.



Vertex of head only moderately elevated above level of pronotal disk, produced in front of eyes, shallowly sulcate between eyes; eyes well separated; antennae filiform, extending about to middle of tegmina; pronotum without well-developed lateral carinae, median carina indicated but not elevated, posterior margin emarginate; tegmina lobate, extending about to or slightly beyond base of tergum 2,<sup>3</sup> apex rounded; prosternal spine well developed, straight or directed slightly posteriorly; mesosternal interspace quadrate to slightly elongate (male), weakly transverse to quadrate (female); metasternal interspace elongate; metasternal lobes nearly contiguous (male), well separated (female); legs of moderate size; hind femur extending about to or moderately beyond apex of abdomen; hind tibiae normally red, pinkish, purplish red, or yellowish buff. Male with furcula reduced to abbreviate lobes, or scarcely present; supra-anal plate triangular, middistal lateral prominences of dorsal surface present and of variable size; apex of subgenital plate conical; male cercus with apex directed ventrad, often decidedly so produced, apical third varying from scarcely wider than middle width to considerably enlarged and lobate dorsally.

*Melanoplus*, *Aeoloplus*, *Hypochlora*, *Agroecotettix*, and many other genera that include brachypterous species are at once distinguished from the present complex by not having the posterior margin of the pronotum emarginate.<sup>4</sup> *Phaedrotettix* shows definite relationship to *Conalcaea* but typically has green hind tibiae, the male cerci are of a different pattern, and the apex of the male subgenital plate is not conical. The Mexican genus *Sinaloa* is another close relative, and the resemblance to *Barytettix* is usually enhanced by orange-colored antennae, but the males have differently shaped cerci, the furcula is represented by long, slender, adjacent processes, and the aedeagus is of a different pattern from that of the present complex. The key by Ball et al. (1942, p. 322)<sup>5</sup> will be found helpful in recognizing the genera of United States specimens likely to be confused with *Conalcaea* and *Barytettix*. At present there is no adequate published key to the genera of Mexican *Melanoplini*.

The species of the *Conalcaea* complex have not been comprehensively treated since Scudder's original description of the gen-

<sup>3</sup> First large visible segment behind pronotum is metanotum.

<sup>4</sup> *Melanoplus gracilis* (Bruner), which does not inhabit the territory occupied by *Conalcaea* and *Barytettix*, has the posterior margin of the pronotum weakly emarginate. The apex of the subgenital plate in the male of *gracilis* is not cone-shaped, as in males of the *Conalcaea* complex, nor are general body coloration and details of the genitalia of either sex comparable.

<sup>5</sup> Unless given directly in the text or in footnotes, references to literature will be found in the citations under the genera and species treated.

era in 1897, and the most important subsequent papers have been those of Hebard and of Rehn, in which three new species were described and several synonyms and generic transfers were indicated. A very brief review of the Arizona species was made by Ball and his associates in 1942.

KEY TO THE GENERA OF THE CONALCAEA COMPLEX

Tegmen longitudinally divided in color; posterior half (actually dorsal half, since these tegmina are functionless and are never spread in life) with pale veins on dark ground color, costal half entirely dark (pl. 10, fig. 3; fig. 58, *g*); antennae brownish, male with dorsal valve of aedeagus enlarged and decidedly produced posteriorly when seen in lateral view (fig. 59).—*Conalcaea* Scudder

Tegmen of uniform color pattern, composed of blackish ground color with superimposed pale veins (pl. 10, fig. 1; fig. 58, *a*); antennae orange (in well-preserved specimens); dorsal valve of aedeagus with no pronounced posterior development seen in lateral view (fig. 64).—*Barytettix* Scudder

The structural pattern of the aedeagus and the general appearance of specimens indicate that two lines of development worthy of generic recognition occur, though external separating characters of a structural nature are somewhat vague. Tegminal color separates nearly all specimens at a glance, but some individuals of *C. miguelitana* do not show the bicolored condition clearly, though belonging in that category. As shown in the photographs (pls. 10, 11), the dark longitudinal bar on the lateral lobe of the pronotum is characteristically interrupted on the prozona by a diagonal pale mark in *Barytettix*, and the bar does not extend onto the metazona. Available specimens of *B. crassus* were originally immersed in alcohol and do not show the pale mark, though properly preserved specimens may do so. *Conalcaea* not only lacks this pale mark, but the dark bar extends across the metazona. Lateral pronotal carinae are indistinct in *Conalcaea*, absent in *Barytettix*. In most species of *Barytettix* the texture of the surface of the metazona is in noticeable contrast with that of the prozona but scarcely contrasted in *Conalcaea*. The dominant body color of *Conalcaea* is brown; in *Barytettix* there is a strong tendency toward green or greenish olivaceous.

Genus CONALCAEA Scudder

*Conalcaea* SCUDDER, Proc. Amer. Acad. Arts Sci., vol. 32, pp. 196, 204, 1897 (Jan.); Proc. U. S. Nat. Mus., vol. 20, pp. 9, 23-26, 1897 (Dec.).—BRUNER, Biologia Centrali-Americana, Orthoptera, vol. 1, pp. 218, 304-305, 1907-1908.—KIRBY, Synonymic catalogue of Orthoptera, vol. 3, p. 493, 1910.—HEBARD, Proc. Acad. Nat. Sci. Philadelphia, vol. 69, pp. 263-264, 1917; Trans. Amer. Ent. Soc., vol. 61, p. 300, 1935.—BALL, TINKHAM, FLOCK, and VORHIES, Arizona Agr. Exp. Stat. Techn. Bull. 93, pp. 323, 329-330, 1942.

*Genotype*—*Conalcaea miguelitana* Scudder, by designation of Scudder, 1897 (December).

Of the other two original species of *Conalcaea* described by Scudder (1897), *neomexicana* is a synonym of *Barytettix humphreysii* (Thomas), and *truncatipennis* is currently being referred elsewhere by Dr. Roberts, who finds it is not congeneric with *miguelitana*.

KEY TO THE SPECIES AND SUBSPECIES OF CONALCAEA

- 1. Male cercus wider in apical third than at base (fig. 60, *b-l*); posterior extensions of dorsal valves of aedeagus conspicuous in posterior view (fig. 59, *e, f, h, i, pe*) (northern Sonora to western New Mexico and northern Arizona) ..... 2
- Male cercus usually slightly narrower in apical third than at base (fig. 60, *a*); no such extensions of dorsal valves of aedeagus as above (fig. 59, *a, b*) (central Mexico) ..... *miguelitana* Scudder
- 2. Male cercus very strongly lobate, the dorsal margin strongly emarginate (fig. 60, *e, f*); supra-anal plate wider at base than long (fig. 63, *h*); dorsal valve of aedeagus elongate in lateral view, anterior margin little produced and that broadly so (fig. 59, *f*) (central Arizona).  
cantralli, new species
- Male cercus either not lobate or much less so than above, the dorsal margin little emarginate (fig. 60, *b-d, g-l*); supra-anal plate scarcely wider than long, usually much narrower; dorsal valve of aedeagus shorter than above, anterior margin either abruptly or broadly produced (fig. 59, *d, g*).  
huachucana Rehn 3
- 3. Male cercus so enlarged in apical third as to appear almost lobate (fig. 60, *b-d*) (north-central Arizona) ..... *huachucana coyoterae* Hebard
- Male cercus variable, not nearly so lobate as above (fig. 60, *i-l*) (southern Arizona, southwestern New Mexico, probably northern Sonora).  
huachucana huachucana Rehn

CONALCAEA MIGUELITANA Scudder

FIGURES 59, *a, b*; 60, *a*; 61; 63, *c, i*; PLATE 10, FIGURE 2

*Conalcaea miguelitana* SCUDDER, Proc. U. S. Nat. Mus., vol. 20, p. 24, pl. 2, fig. 8, 1897; Index North American Orthoptera, p. 81, 1901.—REHN, Proc. Acad. Nat. Sci. Philadelphia, vol. 59, p. 47, 1907.—BRUNER, Biologia Centrali-Americana, Orthoptera, vol. 2, p. 304, 1908.—KIRBY, Synonymic catalogue of Orthoptera, vol. 3, p. 493, 1910.—REHN and HEBARD, Proc. Acad. Nat. Sci. Philadelphia, vol. 64, p. 73, 1912.—HEBARD, Proc. Acad. Nat. Sci. Philadelphia, vol. 69, pp. 263, 274, 1917; Trans. Amer. Ent. Soc., vol. 48, p. 56, 1922.

*Male*.—General form as in plate 10, figure 2; cercus (fig. 60, *a*) slender, apical third usually slightly wider than base; supra-anal plate (fig. 63, *i*) longer than basal width, with conspicuous and decidedly elevated lateral prominences and sharply rounded furcula; dorsal valves of aedeagus shorter than in other species, the posterior extensions well developed (fig. 59, *a*) but not conspicuous in posterior view (fig. 59, *b*); ventral valves of aedeagus

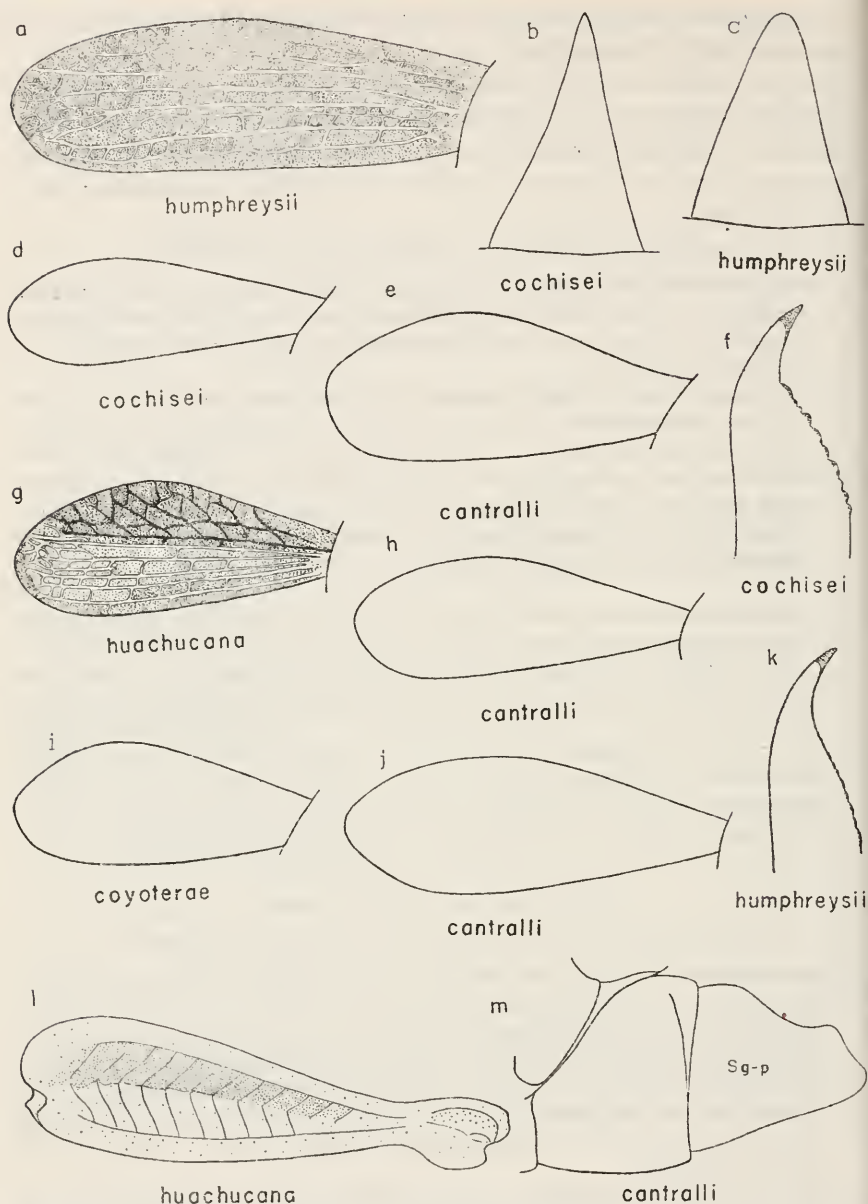


FIGURE 58.—Structural details of *Conalcaea* and *Baryttettix*: a, *B. humphreysii* (Thomas), female, Ajo Mountains, Ariz., adaptation of left tegmen; b, *B. cochisei*, new species, female allotype, outline of right cercus; c, *B. humphreysii*, female, Ajo Mountains, Ariz., outline of right cercus; d, *B. cochisei*, holotype, outline of left tegmen; e, *C. cantralli*, female, allotype, outline of left tegmen; f, *B. cochisei*, female allotype, outline of right dorsal valve of ovipositor; g, *C. huachucana huachucana* Rehn, female, Douglas, Ariz., adaptation of left tegmen; h, *C. cantralli*, holotype, outline of left tegmen; i, *C. h. coyoterae* Hebard, female paratype, Prescott, Ariz., outline of left tegmen; j, *C. cantralli*, female paratype, outline of left tegmen; k, *B. humphreysii*, female, Ajo Mountains, Ariz., outline of right dorsal valve of ovipositor; l, *C. h. huachucana*, female, Douglas, Ariz., left hind femur; m, *C. cantralli*, holotype, outline of apical portion of abdomen, lateral view. (Sg-p, subgenital plate.)



simple, without basal flaps; epiphallus as drawn (fig. 63, *c*), with dorsal margin of lophi (L) oblique and broadly rounded, rather than projecting and narrowly rounded as in the subspecies of *huachucana*.<sup>6</sup>

Coloration: General color varying from pale brown to blackish gray; dark bar of lateral lobes of pronotum weakly developed in some specimens; longitudinal division of tegmen with respect to color evident but not always clear, poorer defined than in other species; hind femur lacks distinct longitudinal bar, partial one sometimes present, ventral margin of paginal area usually black.

Measurements (length in millimeters) of representative specimen: Body, 20; pronotum, 4.5; front femur, 4; hind femur, 12.5; tegmen, 3.5.

*Female*.—Differing from male only with respect to genital segments, and an increased robustness typical of the sex.

Measurements (length in millimeters) of representative specimen: Body, 25.5; pronotum, 5.5; front femur, 4.5; hind femur, 14.5; tegmen, 4.1.

The species superficially resembles *h. huachucana*, but the dorsal swelling in the apical third of the male cercus is less, the furcula and lateral prominences of the supra-anal plate are much more developed, and the dorsal longitudinal stripe on the external face of the hind femur is weak, in addition to different features of the aedeagus.

*Type*.—A male designated by Rehn and Hebard, 1912. Museum of Comparative Zoology, Cambridge, Mass.

*Type locality*.—Sierra de San Miguelito, San Luis Potosí, Mexico.

The lectotype and one male and two female lectoparatypes of Scudder's series have been examined. The male is now deposited in the U. S. National Museum (U.S.N.M. No. 58934). The only other specimens examined were taken by H. R. Roberts at the following localities: 18 miles west of San Luis Potosí, San Luis Potosí, Mexico, 7,500 feet, September 5, 1940 (1 ♂); between Zacapu and Zamora, Michoacán, Mexico, 7,500 feet, September 6, 1938 (23 ♂, 8 ♀); 5 miles south of Chilchota, on road to Urupan, Michoacán, Mexico, 6,000 to 7,000 feet, August 15, 1940 (11 ♂, 7 ♀).

The Arizona record of Bruner (1908) was probably based on material of *h. huachucana*. His record of *miguelitana* from Ciu-

<sup>6</sup> The ancorae, or anterior hooks of the epiphallus (A), appear different in figure 63, *a*, *b*, *c*, owing to the directions in which they point, but I have been unable to find constant differences in fundamental shape. The terminology of the male genitalia is largely that of Roberts (Proc. Acad. Nat. Sci. Philadelphia, vol. 93, pp. 201-246, 1941).

dad, Durango, has not been confirmed. Ciudad is about 75 miles northeast of Mazatlán.

The Roberts specimen from west of San Luis Potosí is almost a topotype, as the type locality is located 10 to 15 miles south and slightly west of that city.

Dr. Roberts informs me that all his specimens of *miguelitana* were collected under ecological conditions varying from open woodland to dry scrub country, none under desert conditions.

CONALCAEA CANTRALLI, new species

FIGURES 58, *c, h, j, m*; 59, *c, f*; 60, *e, f*; 62, 63, *a, d, g, h*; PLATE 10, FIGURE 3

*Male* (holotype).—Size medium to large for genus. Head slightly narrowed in front, basally subequal in width to anterior part of pronotum; pronotum gradually widening posteriorly, shaped as in fig. 63, *d*; tegmen barely extending onto abdominal tergum 2, shaped as in plate 10, figure 3; figure 58, *h*; supra-anal plate wider than long, deeply furrowed medially, the adjacent lateral ridges longitudinally wrinkled, lateral one-third of plate broadly concave on each side, toothlike prominences present, furcula not evident (fig. 63, *h*); cercus conspicuously lobate, the mesal surface excavate in apical third due to curvature, apex projecting somewhat ventrally and more noticeably mesally, exterior surface of apical third shallowly pitted as illustrated (fig. 60, *e*); subgenital plate bluntly conical (fig. 58, *m*); dorsal valves of aedeagus elongate, broadly and inconspicuously projecting anteriorly (fig. 59, *f*, A-m), posterior projection only moderately developed (fig. 59, *c*, pe), posterior surface of apical third darker and of a less membranous texture mesally (*m*) than laterally; ventral valves concave on inner surfaces (*c*), posterior exterior surfaces with small basal flap (*f*); epiphallus with ancorae acute, tapering, directed ventroanteriorly (less triangular in shape than appearing in figure 63, *a*, because of direction of that view), lophi tall, the dorsal margin broadly and evenly rounded.

Coloration: Essentially as in *coyoterae*; disk of pronotum Roman sepia; face and lower part of lateral lobes of pronotum pale brown; ventral surface and lower sides of abdomen straw yellow, also a mediolongitudinal band on terga 2 to 6; dark postocular bar indistinct on head, black and well defined on lateral lobe of prozona, grading into pale brown on ventral half of metazona; dark pattern on meso- and metepisterna typical of *coyoterae*, black on costal half of tegmen, on dorsal half of sides of terga 1 to 7 grading to dark chestnut; antennae pale brown; hind femur with blackish brown longitudinal bar much as in *h. huachucana*; hind tibia vermillion.

Measurements (length in millimeters): Body, 24; pronotum, 5.3; front femur, 4.5; hind femur, 13; tegmen, 4.3. Greatest width of pronotum (posterior, including lateral lobes in perspective from above), 4.3.

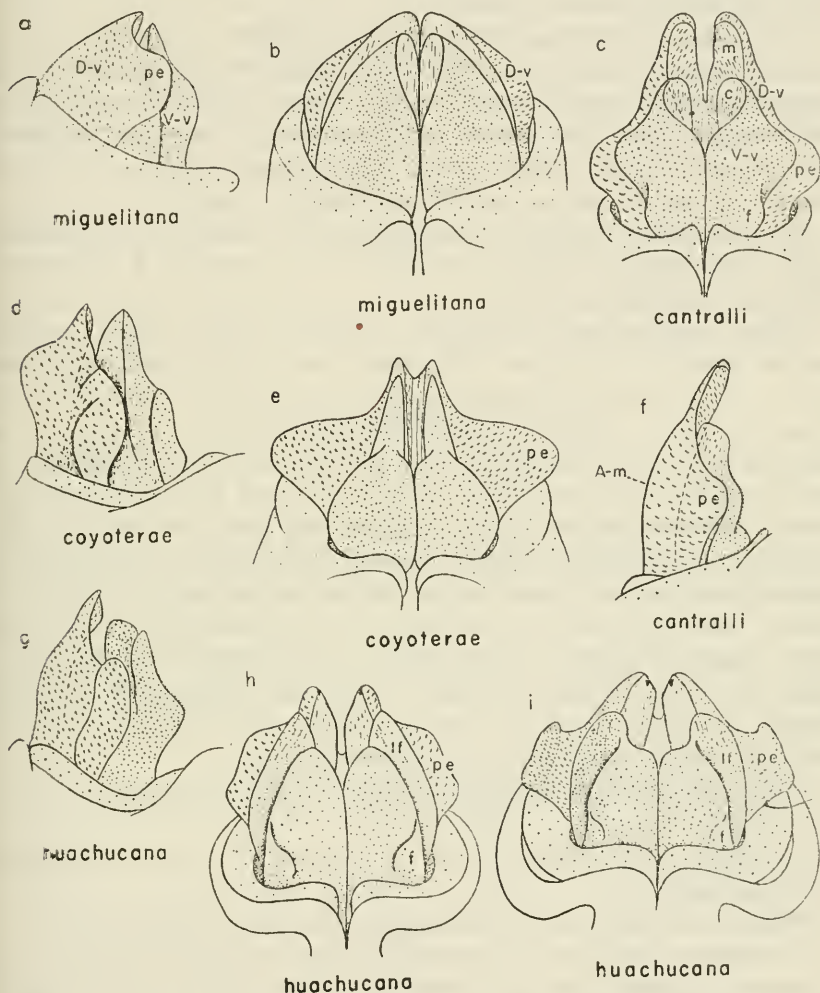


FIGURE 59.—Aedeagus of males of *Conalcaea*: a, *C. miguelitana* Scudder, lectoparatype, lateral view; b, *C. miguelitana*, lectoparatype, dorsoposterior view; c, *C. cantralli*, new species, holotype, dorsoposterior view; d, *C. huachuana coyoterae* Hebard, paratype, Prescott, Ariz., lateral view; e, *C. h. coyoterae*, paratype, dorsoposterior view; f, *C. cantralli*, holotype, lateral view; g, *C. huachuana huachuana* Rehn, Mule Mountains, Ariz., lateral view; h, *C. h. huachuana*, Santa Rita Mountains, Ariz., dorsoposterior view; i, *C. h. huachuana*, Mule Mountains, posterior view. (A-m, anterior margin of dorsal valve of aedeagus; c, concave mesal surface of ventral valve; D-v, dorsal valve; f, basal flap on posterior surface of ventral valve; m, posterior surface of dorsal valve; lf, lateral flap of ventral valve; pe, posterior extension of dorsal valve; V-v, ventral valve.)

*Female* (allotype).—General form as in male, larger and more robust; differing as follows: Face less retreating; eyes less globose; vertex as in figure 63, *g*; posterior emargination of pronotum broader; tegmen proportionally rather broader (fig. 58, *e*); genitalia essentially as in *coyoterae*.

*Coloration*: Differing from male as follows: Face and lower part of lateral lobes of pronotum Van Dyke brown; abdomen and ventral parts largely Roman sepia, terga darkened apically, a mediolongitudinal pale band barely suggested; dark bar on pronotum less sharply defined; dark longitudinal band on left hind femur occupying only anterior two-thirds of pagina.

*Measurements* (length in millimeters): Body, 30; pronotum, 6.5; front femur, 4.3; hind femur, 15.5; tegmen, 4.8. Greatest width of pronotum, 7.3.

There are five male paratypes, the pronotal length of which varies from 4.7 to 5.5 mm. The cerci are slightly variable, those of two specimens exhibiting more dorsal development of the apical lobe (fig. 60, *f*); there is a tendency for the apical margin to be irregular, but in some specimens it is smooth. The aedeagi of two paratypes are preserved in glycerol, and the outline of the dorsal valves in lateral view is less rounded anteriorly than in the holotype. Especially in the dry aedeagi, the extent of the posterior development of the dorsal valves is somewhat variable. The six female paratypes show no significant size variation. Two have more slender tegmina (fig. 58, *j*) than the allotype. The paratypes vary but little in color, beyond exhibiting moderately variable shades of brown on the dorsal surfaces. Two females have an obsolete mediolongitudinal pale abdominal bar.

*Type*.—Museum of Zoology, University of Michigan, Ann Arbor, Mich.

*Paratypes*.—U.S.N.M. No. 59154; Academy of Natural Sciences of Philadelphia.

*Type locality*.—"General Springs," Coconino County, Ariz.

The entire series of six males and seven females was taken at the type locality. The male holotype and five paratypes (1 male, 4 females) were collected on August 28, 1935, by Irving J. Cantrall, one female paratype by him on August 29, 1935. The allotype and five paratypes (4 males, 1 female) were collected August 28, 1935, by T. H. and Grace G. Hubbell.

"General Springs," a fire cabin and lookout station on the Coconino Plateau just at the edge of the Mogollon Rim, is about 12 miles northeast of Pine (Gila County) and about 10 miles east of Baker Butte (Coconino County). All specimens of *cantralli* were taken on the slopes below the rim, mainly along the lower



part of a trail running from the fire cabin (7,200 feet) past "The Tunnel," down to Pieper's Trout Farm. The upper slopes are precipitous, very rocky and with little soil. There are open stands of yellow pine and small white-oak shrubs. Below there are low dense thickets of manzanita, and the variety of trees, shrubs, and herbs increases. Alligator juniper, spruce, fir, and sumac occur there, in addition to oaks, and there is a layer of dead leaves and pine needles. Most of the specimens of *cantralli* occurred among the scrub oaks below "The Tunnel" and were caught with difficulty; some were found amid bracken ferns in a clearing at the edge of the forest.<sup>8</sup>

I am glad to give to this distinctive insect the name of my friend Irving J. Cantrall, who in 1943 published a masterly account of the ecology of the Orthoptera and Dermaptera of the George Reserve, Mich. (Misc. Publ. Mus. Zool. Univ. Michigan, No. 54, 182 pp., 10 pls.).

#### CONALCAEA HUACHUCANA Rehn

Although further confirmatory evidence is desirable, I have concluded on the basis of material examined that there is intergradation of the characters separating *Conalcaea coyoterae* from *C. huachucana* and that these forms represent subspecies. Figure 60, *g*, *h*, demonstrates the intergradation occurring in the shape of the male cercus. The shape of the dorsal valves of the aedeagus also shows intergradation. A series from Greenlee County, Ariz., is particularly intermediate in character. There is a progressive change in cercal shape, and specimens of *huachucana huachucana* from extreme southeastern Arizona have the ventrolateral extremity of the cercus more prolonged than specimens of the same subspecies from more northern localities. A single male of *h. huachucana* from near Gila Bend, Ariz., shows no intergradation with *coyoterae*, and intergradation may prove to occur mainly in the eastern part of Arizona. Ball et al. (1942) record *coyoterae* from the Pinal Mountains (near Globe, Ariz.), and this suggests that the northern form extends farthest south in eastern Arizona.

<sup>1</sup> "The Tunnel" is a historic point on the slope of the Mogollon escarpment, about a mile southeast of the General Springs forest-fire station and near the head of East Verde Creek. Here, in the winter of 1885-86, an abortive attempt was made to construct a railroad tunnel. In placing this and other Arizona localities, the reader is referred to "Arizona Place Names," by Will C. Barnes (Univ. Arizona Bull., vol. 6, No. 1, 503 pp., 1935). Also see Torre-Bueno's "Arizona Insect Localities" (Bull. Brooklyn Ent. Soc., vol. 32, pp. 187-194, 1937).

<sup>2</sup> As an aid to an understanding of the plants mentioned in this paper, readers are referred to Nichol's "The Natural Vegetation of Arizona" (Arizona Univ. Techn. Bull. 68, pp. 181-222, 22 pls., 1 map, 1943), to Benson and Darrow's "A Manual of Southwestern Desert Trees and Shrubs" (Univ. Arizona Bull., vol. 15, No. 2, 411 pp., 114 pls., 1944), and to Kearney and Peebles' "Flowering Plants and Ferns of Arizona" (U. S. Dept. Agr. Misc. Publ. 423, 1,069 pp., 29 pls., 1942).

## CONALCAEA HUACHUCANA HUACHUCANA Rehn

FIGURES 58, *g*, *l*; 59, *g-i*; 60, *g-l*; 62; PLATE 11, FIGURE 3

*Conalcaea huachucana* REHN, Proc. Acad. Nat. Sci. Philadelphia, vol. 59, pp. 48-50, figs. 6, 7, 1907.—SNOW, Trans. Kansas Acad. Sci., vol. 20, p. 163, 1907.—REHN and HEBARD, Proc. Acad. Nat. Sci. Philadelphia, vol. 60, p. 393, 1908; Proc. Acad. Nat. Sci. Philadelphia, vol. 64, p. 100, 1912.—KIRBY, Synonymic catalogue of Orthoptera, vol. 3, p. 493, 1910.—HEBARD, Proc. Acad. Nat. Sci. Philadelphia, vol. 69, p. 263, 1917; Trans. Amer. Ent. Soc., vol. 48, pp. 55-58, pl. 3, figs. 4, 5, 1922; vol. 61, p. 300, 1935.—BALL, TINKHAM, FLOCK, and VORHIES, Arizona Agr. Exp. Stat. Techn. Bull. 93, pp. 329-330, 1942.

*Male*.—General form as in plate 11, figure 3 (specimen illustrated has aedeagus extracted and apex of abdomen elevated more than in average specimens); tegmen usually about as in figure 58, *g*, sometimes more lanceolate; cercus usually as in figure 60, *i-l*, varying as in figure 60, *g*, *h*, in area of intergradation between *h. huachucana* and *h. coyoterae*; supra-anal plate not so wide as long, usually intermediate in proportions between figure 63, *i* and *h*, of *miguelitana* and *cantralli*, furcula consisting of broadly rounded trigonal lobes not so conspicuous as in *miguelitana*, lateral prominences varying from elevated and with considerable lateral development to poorly developed; dorsal valves of aedeagus with only moderate and very broadly rounded swelling anteriorly when seen in lateral view, the posterior extensions conspicuous in posterior view and varying in appearance from knoblike shoulders to wide flaps (fig. 59, *h*, *i*, *pe*); ventral valves of aedeagus with basal flap (fig. 59, *h*, *i*, *f*), closely joined with a lateral flap (*lf*) of variable appearance; epiphallus essentially as in *h. coyoterae* (fig. 63, *b*).

*Coloration*: General color varying from pale brown to dark gray; tegmen of variable color intensity, but longitudinal division normally very distinct, rarely only a few pale veins noticeable; postocular longitudinal blackish band shining, conspicuous.

*Measurements* (length in millimeters) of representative specimen: Body, 21; pronotum, 5; front femur, 4.2; hind femur, 12.5; tegmen, 3.5.

*Female*.—General form more robust than male; dorsal outline of fastigium and eyes as in fig. 63, *f*, of *coyoterae*; dorsal valve of ovipositor scarcely curved in preapical third; cercus moderately acute, shorter than in *cantralli*.

*Measurements* (length in millimeters) of representative specimen: Body, 29; pronotum, 6.3; front femur, 4.5; hind femur, 15; tegmen, 5.

Variation and apparent intergradation with *h. coyoterae* are further discussed under that subspecies.

*Type*.—A male designated by Rehn and Hebard (1912), in Academy of Natural Sciences of Philadelphia.

*Type locality*.—Carr Canyon,<sup>9</sup> Huachuca Mountains, Cochise County, Ariz.

Specimens have been examined from the following localities, in addition to the type locality: NEW MEXICO: Hachita Grande Peak (also called Big Hatchet Peak), Hidalgo County; canyon west-northwest of Hachita Grande Peak. ARIZONA: Maricopa Mountains, 15 miles east of Gila Bend; Santa Catalina Mountains; Chiricahua Mountains; Mule Mountains, Cochise County; Reef;

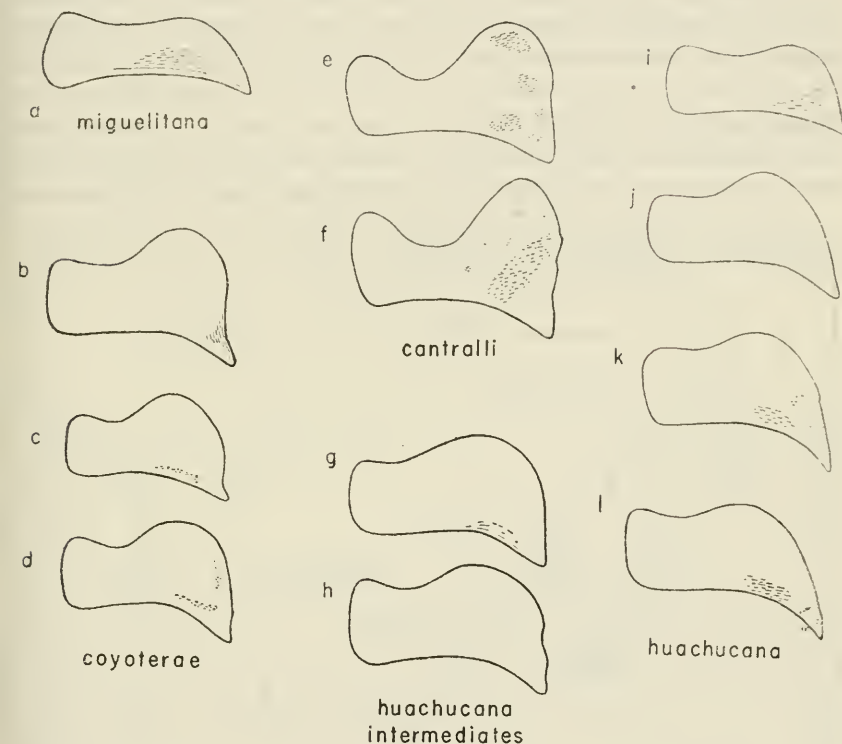


FIGURE 60.—Cerci of male specimens of *Conalcaea*: a, *C. miguelitana* Scudder, lecto-paratype; b, d, *C. huachucana coyoterae* Hebard, topotypes; c, *C. h. coyoterae*, a paratype from Prescott, Ariz.; e, *C. cantralli*, new species, holotype; f, *C. cantralli*, a paratype; g, h, *C. huachucana huachucana* Rehn, intermediates, Hot Air Canyon, Greenlee County, Ariz.; i, *C. h. huachucana*, Chiricahua Mountains, Ariz.; j, *C. h. huachucana*, Reef, Ariz.; k, *C. h. huachucana*, Santa Rita Mountains, Ariz.; l, *C. h. huachucana*, Huachuca Mountains, Ariz.

<sup>9</sup> Carr Canyon is about 5 miles southeast of Huachuca Peak, in the Coronado National Forest. Reef, sometimes known as Palmerlee, is located less than a mile away, and these names are known to entomologists chiefly through collections made there about 1905 by the late C. R. Biederman and the late Charles Schaeffer.

Huachuca Mountains (no detailed locality); Madera Canyon, Santa Rita Mountains; Santa Rita Mountains (no detailed locality); saddle at west base of Old Baldy, Santa Rita Mountains; Sycamore Canyon, Patagonia Mountains, Santa Cruz County; Sycamore Canyon, Baboquivari Mountains, Pima County; Douglas.

Additional published Arizona records are Palmerlee (Rehn and Hebard, 1908), Pinaleno Mountains, and Black River area of the Natanes Plateau (Ball et al., 1942). Specimens from the last-named area might show intergradation with *coyoterae*.

The principal environment occupied by *huachucana* is the open type of chaparral and oak woodland, evidently of the Upper Sonoran and Transition Zones. The following examples of conditions under which *huachucana* was found at a few localities are condensed from data selected by Mr. Rehn from field notes kept by himself and Mr. Hebard: NEW MEXICO: At Hachita Grande Peak a few specimens found on slopes covered with pinyon and having many precipices, up to 7,800 feet on highest peak. In canyon a



FIGURE 61.—Distribution of ■ *Baryttix crassus* Scudder, ● *B. poecilus* (Hebard), and ▲ *Conalcaea miguelitana* Scudder. All localities represented by material examined.



few found near small bushes and in fine grass, not below 5,500 feet; the canyon very extensive, with pebbles, boulders, oaks about 2 feet tall, and much *Nolina*, *Agave*, *Dasyllirion*, *Acacia*, and *Opuntia*. ARIZONA: In Mule Mountains found under and in grasses in forest of high scrub oaks at 6,038 to 7,350 feet; a few individuals on Mount Ballard in heavy wildflowers and grasses up to 6,300 feet. In Upper Madera Canyon, Santa Rita Mountains, found on the ground in dead leaves and among scant herbage under low oaks on canyon floor at 4,900 feet, also up to 5,700 feet; under oaks on slopes of mountain saddles, very few above 6,000 feet, highest at 7,500 feet. In Sycamore Canyon, Patagonia Mountains (at top of pass on only road crossing mountains), found scattered through glades among oaks; very scarce in dead leaves under oaks on way to summit of side peak, one male on bare ground of small opening at top (6,900 feet). In Sycamore Canyon, Baboquivari Mountains (in east face of range, almost due east of Baboquivari Peak), found near groves of mesquite and open stony benches with clumps of short grass.

Collecting dates of adults examined range from July 6 (Palmerlee, Ariz.) to October 9 (Baboquivari Mountains).

CONALCAEA HUACHUCANA COYOTERAE Hebard (new status)

FIGURES 58, *i*; 59, *d*, *e*; 60, *b-d*; 62; 63, *b*, *f*

*Conalcaea coyoterae*<sup>10</sup> HEBARD, Trans. Amer. Ent. Soc., vol. 48, p. 55, pl. 3, figs. 1-3, 1922; Trans. Amer. Ent. Soc., vol. 61, p. 300, 1935.—FRISON, Bull. Illinois, Nat. Hist. Surv., vol. 16, art. 4, p. 142, 1927.—BALL, TINKHAM, FLOCK, and VORHIES, Arizona Agr. Exp. Stat. Techn. Bull. 93, p. 329, 1942.

*Conalcaea neomexicana* SCUDDER, BRUNER, Biologia Centrali-Americana, Orthoptera, vol. 2, p. 305, 1908 (misidentification in part).

The most important feature distinguishing this subspecies is the shape of the male cercus, which in typical specimens is entirely diagnostic (fig. 60, *b-d*). When the aedeagus is examined in lateral view the dorsal valve is seen to be abruptly swollen anteriorly, not moderately and broadly produced as in *C. huachucana huachucana* (fig. 59, *d*). Particularly in dry preparations, the aedeagus varies sufficiently in different individuals to render untrustworthy as subspecific characters the features appearing in a posterior view. The majority of specimens of *coyoterae* from Prescott, Ariz., lack a longitudinal black bar on the dorsal half of the external pagina of the hind femur, such as occurs in *h. huachucana* (fig. 58, *l*). Hebard (1922) noted this, but reported the bar as well developed in a male from Bill Williams Mountain, Ariz., and he concluded that no color

<sup>10</sup> Spelled *coyotero* by Hebard (1935) and Ball et al (1942). The original spelling was correct, in addition to having priority.

feature could be depended upon to separate all specimens of the two forms. Specimens collected at Prescott since the original description was published show that in some individuals the dark bar is complete, in others partially or entirely lacking. The bar occurs in all specimens of *h. huachucana* that I have seen. The general coloration of *coyoterae* is variable and encompasses the same range of shades as the typical subspecies.

Ball et al. (1942) indicate that *coyoterae* is smaller than *h. huachucana*, but the series I have examined suggests that comparable extremes and variation in size occur in each subspecies. The pronotal length of *coyoterae* males from Prescott varies from 4.3 to 5.1 mm., and that of *h. huachucana* varies from 4.2 to 5.2 mm. (extremes from Santa Rita Mountains, Ariz., and Hachita Grande Peak, N. Mex., respectively). Females studied are also comparable, those of *coyoterae* examined ranging in pronotal length from 4.3 to 5.5 mm. (both from Prescott), and Hebard (1922) recorded female paratypes of which the pronotum measured 6.3 mm.

*Type*.—A male originally designated, in Academy of Natural Sciences of Philadelphia.

*Type locality*.—Prescott, Ariz., 5,400 feet elevation.

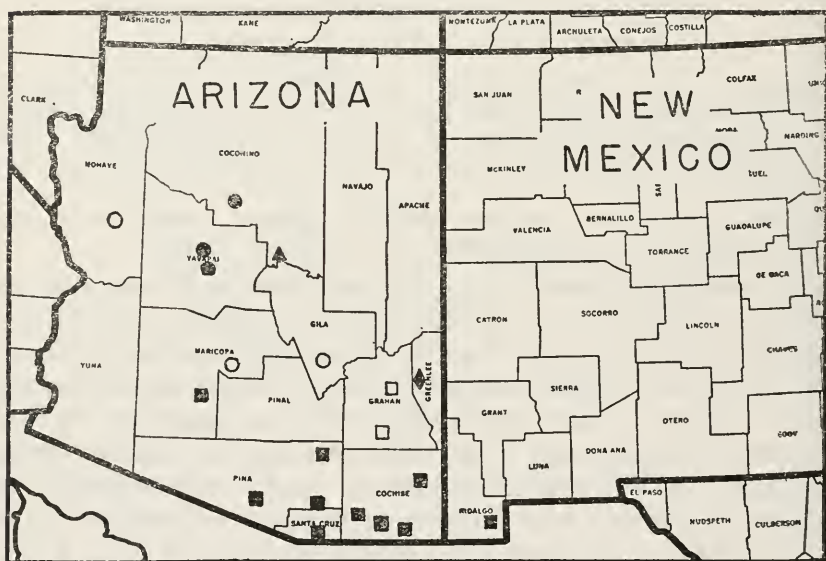
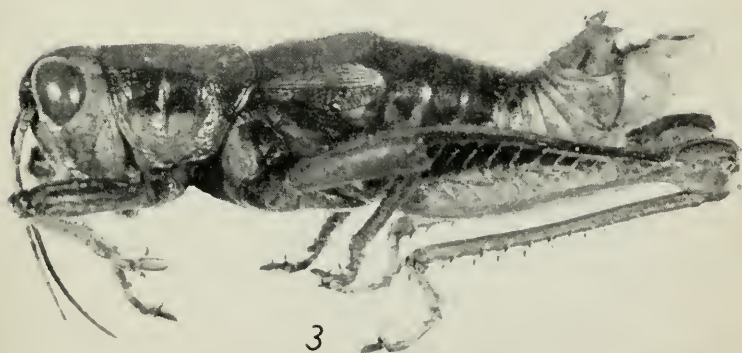
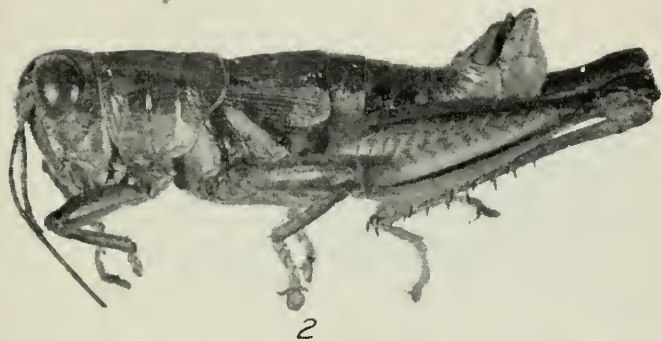
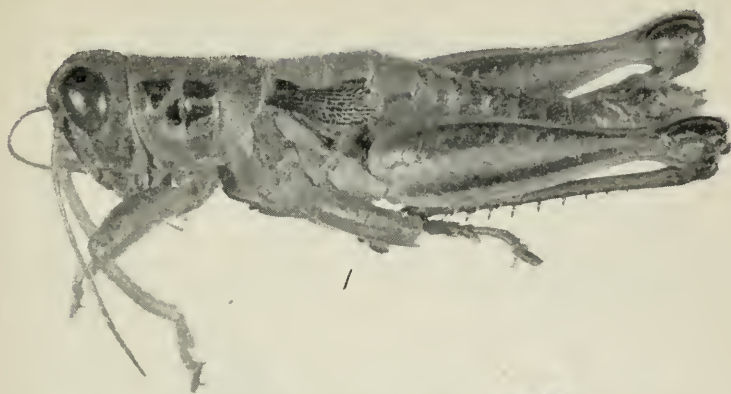
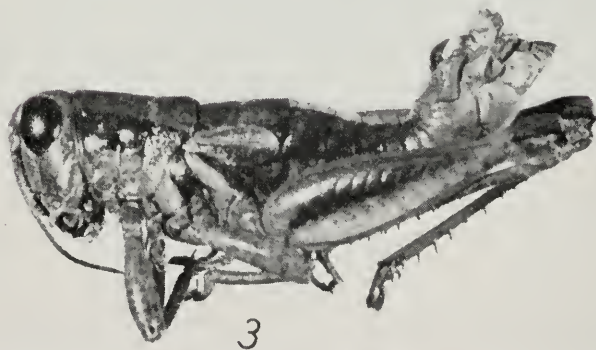


FIGURE 62.—Distribution of *Conalcaea huachucana huachucana* Rehn, *C. huachucana coyoterae* Hebard, and *C. cantralli*, new species: ■ *C. h. huachucana*, material examined; □ *C. h. huachucana*, localities noted in literature from which I have not seen material; ● *C. h. coyoterae*, material examined; ○ *C. h. coyoterae*, localities noted in literature from which I have not seen material; ◆ *C. huachucana*, intermediates, material examined; ▲ *C. cantralli*, material examined.



- 1, *Barytettix poecilus* (Hebard): Male paratype from Venvidio, Sinaloa, Mexico.
- 2, *Conalcaea miguelitana* Scudder: Male from 18 miles west of San Luis Potosí, San Luis Potosí, Mexico.
- 3, *Conalcaea cantralli*, new species: Male holotype.



- 1, *Barytettix humphreysii* (Thomas): Female from foothills of the Huachuca Mountains, Ariz.  
2, *Barytettix cochisei*, new species: Male paratype from Douglas, Ariz.  
3, *Conalcaea huachucana huachucana* Rehn: Male from Reef, Ariz.



I have examined a male from Bill Williams Mountain (near Williams), Coconino County, Ariz., in addition to many specimens from Prescott. The intergrades include five males and four females from Hot Air Canyon, Greenlee County, Ariz., taken from a wild turkey by L. L. Hargrave, October 25, 1939. Hebard's original series, which I have seen, also included specimens from Senator, Yavapai County, Ariz., and two localities in the environs of Prescott: Mount Union and Granite Peak. Hebard (1935) says that Phoenix, Ariz., material recorded by Bruner (1908) as *C. neomexicana* is in reality *coyoterae*.

Other localities given by Ball et al. (1942) are the Pinal and Hualapai Mountains. I suspect that the Pinal Mountain material may show intergrading characters comparable to those of the Hot Air Canyon series.

Adults of typical *coyoterae* collected from July 13 to September 14 have been seen. Ball et al. note adults as late as October 3 and say that overwintering occurs in the egg stage. A series taken at Prescott, July 29, 1933, by Dr. Beamer shows that adults were numerous but that some nymphs could still be found.

This subspecies is an inhabitant of the chaparral and oak zone of the Upper Sonoran Zone, the entire original series having been taken at an elevation of from 5,400 to 6,500 feet. Hebard (1922) says it is probably strictly geophilous, and Ball et al. say it feeds on low plants such as *Eriogonum* and *Lactuca*.

#### Genus BARYTETTIX<sup>11</sup> Scudder

*Barytettix* SCUDDER, Proc. Amer. Acad. Arts and Sci., vol. 32, pp. 197, 204, 1897 (January); Proc. U. S. Nat. Mus., vol. 20, pp. 10, 27-29, 1897 (December).—BRUNER, Biologia Centrali-Americana, Orthoptera, vol. 2, pp. 218, 305, pl. 4, figs. 8, 8a, 8b, 9, 1907-1909.—KIRBY, Synonymic catalogue of Orthoptera, vol. 3, pp. 494, 585, 1910.—HEBARD, Proc. Acad. Nat. Sci. Philadelphia, vol. 69, pp. 263-264, 1917; Trans. Amer. Ent. Soc., vol. 61, pp. 300, 303, 1935.

*Genotype*.—*Barytettix crassus* Scudder, 1897, by designation of Scudder (1897, December).

The genus *Barytettix* has characters noted for the complex and for separating it from *Conalcaea*. In 1917 Hebard placed *Barytettix* as a synonym of *Conalcaea*, but the aedeagus had not then been investigated. It shows that two cohesive groups of species are actually represented, supporting the separation suggested by general habitus and color. It is true, however, that the character used by Scudder (shape of mesosternal interspace) to separate the two genera is not dependable. Furthermore, Scudder placed his *Conalcaea neomexicana*, the type of which I have seen, in the

<sup>11</sup> Not to be confused with *Barytettix* Günther, 1939, the preoccupied name of a genus of grouse locusts for which Rehn (Ent. News, vol. 59, p. 155, 1948) has proposed a substitute.

wrong genus. It is actually a synonym of *B. humphreysii* (Thomas), and Hebard (1935) has explained that Scudder was confused additionally by mistakenly assuming *B. humphreysii* to be the species now known as *Melanoplus aridus* (Scudder).

A second species that Scudder placed in *Barytettix* has since been transferred by Hebard (Trans. Amer. Ent. Soc., vol. 51, p. 288, 1925) to still another of Scudder's genera, where it is known as *Sinaloa peninsulæ* (Scudder). The four species of *Barytettix* now recognized may be separated as follows:

#### KEY TO SPECIES OF BARYTETTIX

1. Basal lobe of aedeagus enlarged, extending far up on ventral valves (fig. 64, *a-d*) (New Mexico, Arizona, Sonora)..... 2
- Basal lobe of aedeagus small, extending but little up ventral valves (fig. 64, *e-h*) (Baja California, Sinaloa, Nayarit)..... 3
2. Male with apices of ventral valves of aedeagus erect and close together in posterior view (fig. 64, *b*); reddish color of hind tibiae, knees of hind femora, and of external male terminalia often conspicuously developed.  
*cochisei*, new species
- Male with apices of ventral valves of aedeagus broadly curved and widely separated in posterior view (fig. 64, *d*); reddish color inconspicuous on external male terminalia, present or absent on hind tibiae and knees.  
*humphreysii* (Thomas)
3. Cercus of male almost rectangular, apex scarcely prolonged (fig. 64, *l*); dorsal valves of aedeagus widely separated apically (fig. 64, *h*) (Sinaloa, Nayarit).....*poecilus* (Hebard)
- Cercus of male with apex considerably prolonged (fig. 64, *k*); dorsal valves of aedeagus contiguous (fig. 64, *f*) (Baja California).....*crassus* Scudder

#### BARYTETTIX COCHISEI,<sup>22</sup> new species

FIGURES 58, *b, d, f*; 64, *a, b, i, m*; 65; PLATE 11, FIGURE 2

*Conalcaea humphreysii poecila* Hebard, BALL, TINKHAM, FLOCK, and VORHIES, Arizona Agr. Exp. Stat. Techn. Bull. 93, pp. 329-330, 1942 (misidentification, in part).—TINKHAM, Amer. Midl. Nat., vol. 38, pp. 145-146, 1947 (misidentification, in part).

*Male*. (holotype).—Size medium for genus; general form as in plate 11, figure 2. Pronotum subcylindrical, prozona of uniform width, metazona flaring, posterior margin broadly emarginate; tegmen extending to base of tergum 1, shape as in figure 58, *d*; cercus decidedly concave mesally, outline of exterior surface essentially as in figure 64, *i*, less concave on ventral margin; subgenital plate bluntly conical; supra-anal plate broadly triangular, furcula represented by broadly rounded lobes, lateral prominences tiny but sharp; dorsal valves of aedeagus much shorter than ventral valves, both tapering and apically acute, the latter with

<sup>22</sup> Cochise was a chief of Chiricahua Apache Indians, who died in 1874 after leading attacks against white men for 10 years, 1861-1871. His name was given to the most southeasterly county of Arizona, which is an area typical of that occupied by this species.

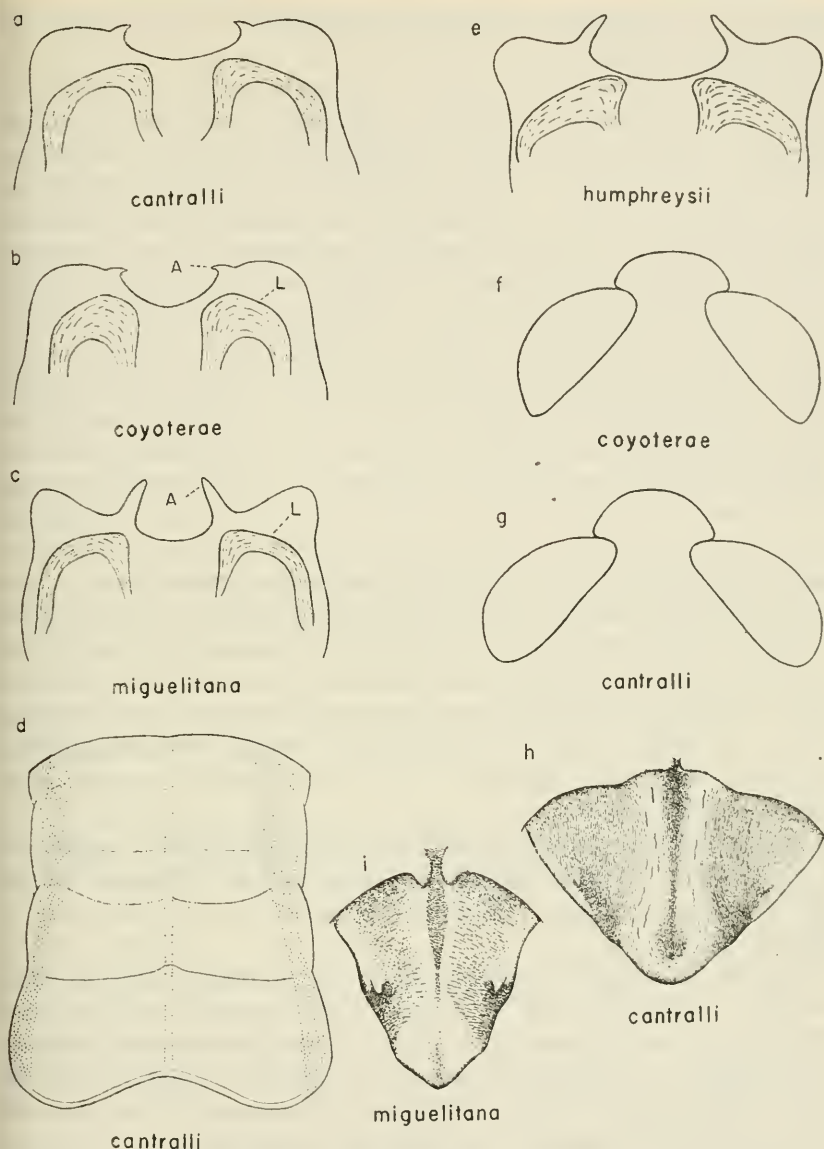


FIGURE 63.—Structural details of *Conalcaea* and *Barytettix*: a, *Conalcaea cantralli*, new species, holotype, dorsoposterior view of epiphallus; b, *C. huachucana coyoterae* Hebard, paratype, Prescott, Ariz., dorsoposterior view of epiphallus; c, *C. miguelitana* Scudder, lectoparatype, dorsoposterior view of epiphallus; d, *C. cantralli*, holotype, dorsal view of pronotum, lateral lobes shown in perspective; e, *B. humphreysii* (Thomas), Santa Catalina Mountains, Ariz., dorsoposterior view of epiphallus; f, *C. huachucana coyoterae*, female paratype, Prescott, Ariz., dorsal view of vertex and eyes; g, *C. cantralli*, allotype, dorsal view of vertex and eyes; h, *C. cantralli*, holotype, supra-anal plate; i, *C. miguelitana*, male lectoparatype, supra-anal plate. (A, ancora; L, lophus.)

apices close together; epiphallus essentially as illustrated for *humphreysii* (fig. 63, e).

Coloration: General coloration olivaceous-green, marked with yellow and vermilion, shading to pale brown on apical third of abdomen. Head gray, paler on mouth parts, a narrow postocular yellow stripe ventrally edged with black on each side of vertex; eyes pale brown; basal two antennal segments greenish ash; basal half of flagellum vermilion, gradually darkening to brown at apex; disk of prozona of pronotum brownish green, bordered by slightly inbowed shiny yellow longitudinal stripes in the position of lateral carinae; lateral lobes of prozona shining black above, grading to brownish green at ventral margins, marked with bright yellow as in plate 11, figure 2, plus a poorly developed additional horizontal yellow bar through the posterior black area; metazona olivaceous-green, posteriorly margined with pale green; tegmen with blackish ground color, the veins pale yellow and duller near costal margin in basal half; front and middle legs olivaceous, paler beneath and on tarsi; hind femur yellow, pinkish on genicular lobe, brown above and on dorsal half of pagina, dorsal carinae blackish brown, ventral margin of pagina dark green; hind tibiae vermilion, tarsi pale pink, apical half of claws, spurs, and spines black; abdomen varying from brownish green at base to pale brown in apical third, a narrow pale brown mediolongitudinal stripe inconspicuous; supra-anal plate, cerci, and subgenital plate tinged with pinkish.

Measurements (length in millimeters): Body, 25.5; pronotum, 5; front femur, 4; hind femur, 12.5; tegmen, 4.3. Greatest width of pronotum (posterior, including lateral lobes in perspective from above), 4.7.

*Female* (allotype).—General form more robust than in male and face less retreating in lateral view, much as in illustrated specimen of *humphreysii* (pl. 11, fig. 1) but more elongate owing to extension of abdominal segments. Cercus elongate, apically very acute (fig. 58, b); ovipositor with dorsal valve scarcely curved on dorsal margin in apical fourth (fig. 58, f).

Coloration: As in male, except that head and thorax are more brownish than olivaceous-green, and yellow markings are less bright.

Measurements (length in millimeters): Body, 32.5; pronotum, 6.7; front femur, 4.6; hind femur, 16.7; tegmen, 5.7. Greatest width of pronotum, 6.7.

There are 12 male paratypes, varying in pronotal length from 5.1 to 6 mm. and in body length from 24 to 26 mm. The largest males are from Don Luis. No important variation of the cercus



has been noted, the slight differences observed being mainly due to warping in drying. The supra-anal plate (fig. 64, *m*) has the height of lateral prominences slightly variable. When the aedeagus is extracted and allowed to dry in situ, the basal lobe is likely to curl, so that the resulting lateral view does not agree with the wet condition (fig. 64, *a*). The posterior view demonstrates entirely diagnostic characters, however, in either wet or dry preparations. The four female paratypes vary in pronotal length from 6.3 to 7 mm. and in body length from 29 to 31 mm. In two of the females the cercus is less acute than in the allotype (fig. 58, *b*), though still sharply triangular. The subapical portion of the dorsal valve of the ovipositor is scarcely curved, showing some difference from *humphreysii* in this respect (fig. 58, *f*, *k*). I have not found the shape of cercus and ovipositor sufficiently helpful as separating characters, however, to include them in the key to species.

In general coloration there is a variable intensity of the olivaceous-green, a few specimens being more brownish, with yellow thoracic markings nearly the same shade as the background color. About half of the series has the lateral pronotal lobe as in plate 11, figure 2, the other having an additional yellow mark as in the holotype. In some it is indistinct, showing the feature to be variable. The lower half of the pagina on the exterior face of the hind femur is dull straw color, rather than a distinct yellow, in all the female paratypes, and in two of the males that area is greenish yellow and blends gradually with dark greenish brown on the dorsal half of the pagina. Nine of the males are decidedly reddish on the genital segments; the other three are inconspicuously tinged with pink. The ovipositor valves of the females vary from pale brown to pinkish yellow; the female supra-anal plate is brown.

*Type*.—U.S.N.M. No. 59155.

*Paratypes*.—In Museum of Zoology, University of Michigan, Ann Arbor, Mich.; Academy of Natural Sciences of Philadelphia; Museum of Comparative Zoology, Cambridge; University of Kansas, Lawrence; California Academy of Sciences, San Francisco; collection of W. W. Jones, Douglas, Ariz.

*Type locality*.—Douglas, Cochise County, Ariz.

The male type, allotype, and two male paratypes were taken at the type locality by W. W. Jones, September 10, 1944. Other paratypes taken at Douglas by Mr. Jones include one male and two females, October 22, 1944; one female, October 23, 1932; one female, August 20, 1933; one male, September 20, 1924; one male, October 10, 1943; one male (no date). Two paratypic males are from Don Luis, Cochise County Ariz., September 24, 1922 (Rehn

and Hebard) ; one is from Madera Canyon, Santa Rita Mountains, Ariz., September 10, 1931 (E. R. Tinkham) ; and three are from 2 miles southwest of Chiracahua, San Bernardino Valley, Cochise County, Ariz., 4,650 feet elevation, August 27, 1937 (Rehn, Pate, and Rehn). One female taken at Douglas, Ariz., August 25, 1944, by K. R. Hobbs, is not considered paratypic because lack of association with males and uncertainty over its characters make its identity somewhat doubtful.

Certain of the Arizonan and Sonoran specimens referred to *Conalcaea humphreysii poecila* by Ball et al. (1942) and Tinkham (1947) probably represent *cochisei*, and possibly those from Copete Mine, Sonora, also referred to *humphreysii* by Hebard (Trans. Amer. Ent. Soc., vol. 51, p. 291, 1925). The reader is referred to my comments on this subject under *Barytettix humphreysii* and *B. poecilus*.

Douglas, the type locality, is just north of the Mexican boundary in a small area of the southern desert characterized by the creosotebush and the saltbush. Don Luis is located at the south base of the Mule Mountains, about 3 miles southwest of the town of Bisbee. The Don Luis specimens were taken on "low easy slopes, open with short grass and a scattering of other desertland vegetation, such as ocotillo (*Fouquieria*), creosotebush, etc."

#### BARYTETTX HUMPHREYSII (Thomas)

FIGURES 58, a, c, k; 63, e; 64, c, d, j; 65; PLATE 11, FIGURE 1

- Pezotettix humphreysii* THOMAS, Report of geographical and geological explorations west of the one-hundredth meridian, vol. 5, pp. 890-892, pl. 45, figs. 1, 2, 1875.—CAUDELL, Ent. News, vol. 22, p. 165, 1911.
- Conalcaea neomexicana* SCUDDER, Proc. U. S. Nat. Mus., vol. 20, pp. 24, 26, pl. 2, fig. 9, 1897; Catalogue of the Orthoptera of the United States and Canada, Proc. Davenport Acad. Nat. Sci., vol. 8, p. 48, 1899.—BRUNER, Biologia Centrali-Americana, Orthoptera, vol. 2, p. 305, 1908.—SCUDDER and COCKERELL, Proc. Davenport Acad. Nat. Sci., vol. 9, p. 40, 1902.—CAUDELL, Proc. U. S. Nat. Mus., vol. 28, p. 476, 1905.—REHN, Proc. Acad. Nat. Sci. Philadelphia, vol. 59, p. 47, 1907.—KIRBY, Synonymic catalogue of Orthoptera, vol. 3, p. 493, 1910.—REHN and HEBARD, Proc. Acad. Nat. Sci. Philadelphia, vol. 64, p. 74, 1912.—HEBARD, Proc. Acad. Nat. Sci. Philadelphia, vol. 69, pp. 264, 275, 1917.
- Barytettix borealis* CAUDELL, Proc. Ent. Soc. Washington, vol. 9, pp. 69-70, 1908.—KIRBY, Synonymic catalogue of Orthoptera, vol. 3, 585, 1910.—CAUDELL and HEBARD, Proc. Acad. Nat. Sci. Philadelphia, vol. 64, p. 162, 1912.
- Barytettix neomexicana* SCUDDER, PIERCE, and MORRILL, Proc. Ent. Soc. Washington, vol. 16, p. 22, 1914.
- Conalcaea humphreysii* Thomas, KIRBY, Synonymic catalogue of Orthoptera, vol. 3, p. 493, 1910.—HEBARD, Trans. Amer. Ent. Soc., vol. 51, pp. 290-291, 1925; Trans. Amer. Ent. Soc., vol. 61, p. 300, 1935.—BALL, TINKHAM, FLOCK, and VORHIES, Arizona Agr. Exp. Stat. Techn. Bull. 93, pp. 329-330, 1942.—TINKHAM, Amer. Midl. Nat., vol. 38, pp. 145-146, 1947.

*Conalcaea humphreysii poecila* Hebard, BALL, TINKHAM, FLOCK, and VORHIES, Arizona Agr. Exp. Stat. Techn. Bull. 93, pp. 329-330, 1942 (in part).

**Male.**—Essentially like *cochisei* except in key characters noted; averaging more robust. Cercus (fig. 64, *j*) with ventroapical angle averaging more acute than in *cochisei* but not sufficiently different to serve as a separating character; furcula, supra-anal plate and subgenital plate about as in *cochisei*; ventral valves of aedeagus with apices widely separated and incurved (fig. 64, *d*).

Coloration: Pattern as in *cochisei*, but general tone brownish rather than greenish olivaceous; hind tibia usually yellowish buff but occasionally bright red; abdomen usually pale brown, averaging lighter than in *cochisei* and with scarcely any pinkish tinge on external genitalia.

Measurements (length in millimeters) of representative specimen: Body, 27; pronotum, 6.1; front femur, 4.8; hind femur, 14.5; tegmen, 4.2.

**Female.**—General form as in plate 11, figure 1, not separable with certainty from *cochisei* except by association with male; tegmen variable, usually narrower at base than in figure 58, *a*; dorsal valve of ovipositor decidedly upturned at apex (fig. 58, *k*); cercus blunt to moderately acute.

Coloration: As in male.

Measurements (length in millimeters) of representative specimen: Body, 31; pronotum, 6.6; front femur, 4.7; hind femur, 16.5; tegmen, 5.7.

Males examined vary in pronotal length from 4.8 mm. (Santa Rita Mountains) to 7.5 mm. (Baboquivari Mountains), and from 21.5 to 32 mm. in body length. Females vary in pronotal length from 5.7 mm. (Huachuca Mountains) to 8.3 mm. (Ajo Mountains), and from 19.5 to 36 mm. in body length.

The only dependable character I have found for separating *humphreysii* from *cochisei* is the aedeagus, although freshly collected or well-preserved specimens of *cochisei* are usually more greenish olivaceous than *humphreysii*, and there is more red on the hind legs and external genitalia. Ball et al. (1942) and Tinkham (1947) probably did not study the aedeagus, and certain specimens with considerable red were referred to *poecila*, as demonstrated by material of *humphreysii* here recorded from the Ajo Mountains, which was sent to me by Dr. Tinkham as representative of *humphreysii poecila*. It is now known that those authors were quite correct in realizing that a form related to typical *humphreysii* occurs in southern Arizona and Sonora, and without studying the aedeagus it was natural to assume that the additional form might be a subspecies of *humphreysii*. My examination of the type of *poecila* shows that the identification was incorrect.



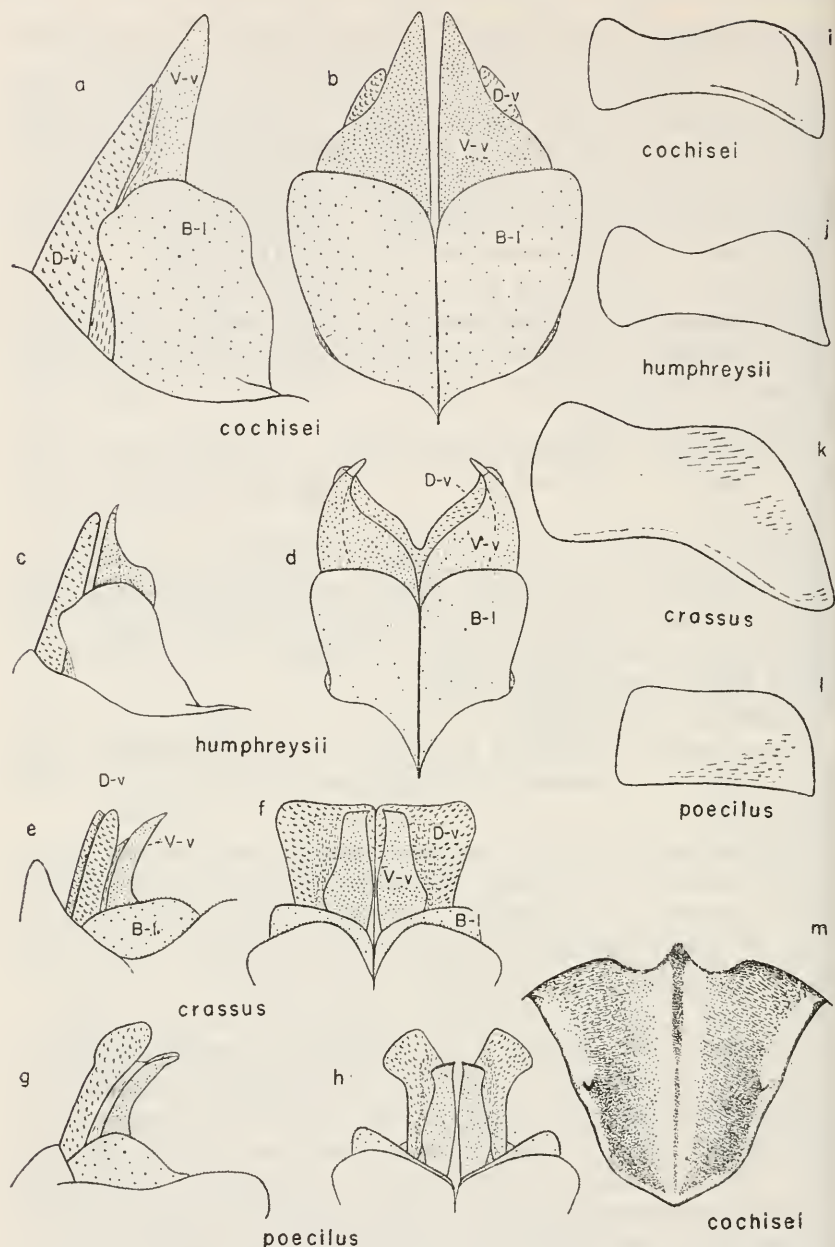


FIGURE 64.—Structural details of male specimens of *Baryttettix*: a, *B. cochisci*, new species, holotype, lateral view of aedeagus; b, *B. cochisei*, dorsoposterior view of aedeagus; c, *B. humphreysii* (Thomas), Santa Catalina Mountains, Ariz., lateral view of aedeagus; d, *B. humphreysii*, Santa Catalina Mountains, Ariz., dorsoposterior view of aedeagus; e, *B. crassus* Scudder, topotype, lateral view of aedeagus; f, *B. crassus*, dorsoposterior view of aedeagus; g, *B. poecilus* (Hebard), paratype, Villa Union, Sinaloa, Mexico, lateral view of aedeagus; h, *B. poecilus*, paratype, Villa Union, Sinaloa, Mexico, dorsoposterior view of aedeagus; i, *B. cochisei*, paratype, Douglas, Ariz., cercus; j, *B. humphreysii*, Santa Catalina Mountains, Ariz., cercus; k, *B. crassus*, topotype, cercus; l, *B. poecilus*, paratype, Villa Unión, Mex., cercus; m, *B. cochisei*, paratype, Don Luis, Ariz., supra-anal plate. (B-l, basal lobe of aedeagus; D-v, dorsal valve; V-v, ventral valve.)





Specimens of *humphreysii* from the following localities have been examined. NEW MEXICO: Silver City, Grant County. ARIZONA: Verde Valley, directly north of Clarksdale; Clarksdale; Globe; Phoenix; Sabino Basin, Santa Catalina Mountains; Pima Canyon, Santa Catalina Mountains; Santa Catalina Mountains (2 lots, no detailed locality); Douglas; Madera Canyon, Santa Rita Mountains; Stone Cabin Canyon, Santa Rita Mountains; 2 miles north of Oro Blanco, Tumacacori foothills, Santa Cruz County; Atascosa Mountain, Pajaritos Mountains, Santa Cruz County; Nogales; Coyote Mountains, at north end of Baboquivari range; Sycamore Canyon, Baboquivari Mountains, almost due east of Baboquivari Peak; Schaeffer Canyon, Baboquivari Mountains, at north base of Mount Mildred on east face of Baboquivari range; Baboquivari Mountains (no detailed locality); Fortification Rock, Baboquivari Valley, east-southeast of San Miguel; Fresnal; Alamo Canyon, Ajo Mountains, about 30 to 40 miles southeast of Ajo.

Hebard (1925) reported one male and nine females of *humphreysii* from the Copete mine, 30 miles east of Carbo, Sonora. He commented on the fact that the majority of that series differed from Arizona material in having redder hind tibiae. Without examining the male, it cannot be known whether *humphreysii* or *cochisei* was represented. Other localities mentioned in literature, from which I have not seen material, are the northern area of Sonora cited by Tinkham (1947) and the Galiuro Mountains and Chiricahua Mountains of Arizona (Ball et al., 1942). Hebard (1917) noted that Kirby (1910) incorrectly recorded *neomexicana* from Mexico, there then being no authentic record from that country of *humphreysii* or its synonyms.

*Barytettix humphreysii* is found from the northern part of the Lower Sonoran Zone through the Upper Sonoran. Tinkham (1947) considers it "one of the characteristic and dominant species" of what he calls "the Sonoran Live Oak Zone of the Upper Sonoran." In several instances, as in Schaeffer Canyon and in the Coyote Mountains, Mr. Rehn's notes record finding *humphreysii* lower on the desert foothills than the zones occupied by oaks, but in other places (Sabino Basin; Atascosa Mountain) it occurred in both strong and scattered stands of oaks. Sahuaro (*Carnegiea gigantea* Britton and Rose), paloverde (*Cercidium* or *Parkinsonia*), cholla (*Opuntia*) and sotol (*Dasylirion*) were dominant plants often characteristic of the habitats. In the Coyote Mountains, *humphreysii* was found in "pockets" of such plants between great boulders on very steep, rugged south slopes of a canyon. Again, groves of oaks and acacia, interspersed with clumps of fine grasses, were typical surroundings. In Sycamore

Canyon of the Baboquivari Mountains, it occurred on grassy benches along the sides of a canyon. In both the Santa Rita and the Santa Catalina Mountains, *humphreysii* has been found on desert cotton (*Gossypium thurberi* Todaro), but it is not precisely known to be a host plant.<sup>13</sup>

Adults examined were collected as early as the month of April and as late as November 15 (both extremes in the Baboquivari Mountains of Arizona), though most collections have been made from July to late October.<sup>14</sup>

Altitudes at which *humphreysii* occurs have been recorded above 6,000 feet, but most records are from 3,000 to 5,000 feet, and it appears that this is typically a species of lower altitudes than those preferred by *Conalcaea huachucana*.

**BARYTETTIX POECILUS (Hebard), new combination**

FIGURES 61; 64, *g, h, l*; PLATE 10, FIGURE 1

*Conalcaea poecila* HEBARD, Trans. Amer. Ent. Soc., vol. 51, pp. 267, 290–292, pl. 7, fig. 7, pl. 8, fig. 4, 1925.

*Conalcaea humphreysii poecila* Hebard, BALL, TINKHAM, FLOCK, and VORHIES, Arizona Agr. Exp. Stat. Techn. Bull. 93, pp. 329–330, 1942 (in part).—TINKHAM, Amer. Midl. Nat., vol. 38, pp. 145–146, 1947 (in part).

**Male.**—General form as in plate 10, figure 1; cercus scarcely curved mesally when seen from above, the apex broadly rounded, ventral margin weakly curved, the ventroapical angle little produced (fig. 64, *l*); furcula about as in *cochisei* (fig. 64, *m*), the lobes a little smaller and more abruptly demarked laterally; supra-anal plate shaped about as in *Conalcaea miguelitana* (fig. 63, *i*), the dorsolateral prominences varying from minute, as in the figure of *cochisei*, to about twice the size of those illustrated in *C. miguelitana*; epiphallus much as in *humphreysii* (fig. 63, *e*), the apical margin of lophi more roundly and evenly curved, the ancorae somewhat larger; dorsal valves of aedeagus slender, narrowed basally, divergent apically (fig. 64, *h*).

**Coloration:** General color varying from pale yellowish green to dark olive-green. Antennae reddish orange, darker in apical fourth; eyes russet; black pattern, edged with yellow, on lateral lobes of pronotum; hind femur varying from solid green, with darkened carinae and knees, to yellowish, with green on carinae and dorsal half of pagina, dark area of knees usually brownish purple; hind tibia purple, the spines and spurs black apically; hind tarsus pale purple to brown; supra-anal plate and cerci often reddish brown.

<sup>13</sup> Pierce and Morrill (Proc. Ent. Soc. Washington, vol. 16, p. 22, 1914).

<sup>14</sup> Hebard (Ent. News, vol. 44, pp. 231–235, 1933) has noted a few winter and early spring Orthoptera in the vicinity of Tucson, Ariz., but does not mention *Conalcaea* or *Barytettix*.



Measurements (length in millimeters) of representative specimen: Body, 29; pronotum, 5.9; front femur, 5.5; hind femur, 16; tegmen, 5.

*Female*.—Very much like *humphreysii* except in color, which agrees with that of the male.

Measurements (length in millimeters) of a paratype: Body, 33; pronotum, 7; front femur, 5.5; hind femur, 19.3; tegmen, 6.

Pronotal length of males varies from 5.7 (Venvidio) to 6.5 mm. (Villa Union), body length from 25.5 (Compostela) to 29.5 mm. (Villa Union). Females are recorded by Hebard (1925) as ranging from 6.7 (Venvidio) to 8 mm. (Villa Unión) in pronotal length, from 28.3 to 37.2 mm. in body length.

*Type*.—A male in the Academy of Natural Sciences of Philadelphia, collected August 28, 1918, by J. A. Kusché, and designated in the original description.

*Type locality*.—Venvidio, Sinaloa, Mexico (Venvidio is evidently near Los Mochis).

In addition to the type locality, the species is known from only two localities, from both of which I have seen material: Villa Union (about 15 miles southeast of Mazatlán), Sinaloa, Mexico. Vicinity of Compostela (about 25 miles south of Tepic), Nayarit, Mexico.

The male from Compostela is the only specimen that has not been recorded previously.

Records of *poecilus* from Arizona, and probably all those from Sonora by Ball et al. (1942) and Tinkham (1947) are in error, these applying to either *humphreysii* or *cochisei*.

Adult collection dates range from July 30 (Compostela) to September 27 (Villa Unión). No detailed information on habitats is available. The coastal region of Sinaloa and Nayarit belongs to the Tropical Zone, and the conspicuous native vegetation is largely of a scrub nature, chiefly mesquite, yucca, agave, cactus, and other plants.

BARYTETTIX CRASSUS Scudder

FIGURES 61; 64, e, f, k

*Barytettix crassus* SCUDDER, Proc. U. S. Nat. Mus., vol. 20, pp. 27-28, pl. 2, fig. 10, 1897; Index North American Orthoptera, p. 37, 1901.—BRUNER, Biologia Centrali-Americana, orthoptera, vol. 2, p. 305, pl. 4, figs. 8, 8a, 8b, 9, 1908-1909.—KIRBY, Synonymic catalogue of Orthoptera, vol. 3, p. 494, 1910.—REHN and HEBARD, Proc. Acad. Nat. Sci. Philadelphia, vol. 64, p. 74, 1912.

*Conalcaea crassa* (Scudder) HEBARD, Proc. Acad. Nat. Sci. Philadelphia, vol. 69, pp. 264, 274, 1917; Trans. Amer. Ent. Soc., vol. 51, p. 290, 1925.

*Melanoplus nitidus* SCUDDER, Proc. U. S. Nat. Mus., vol. 20, pp. 207-208, 1897 (in part).



*Male*.—General form as in *humphreysii*; hind femur clearly more robust than in *poecilus* and slightly more so than in *humphreysii*; cercus (fig. 64, *k*) broadly produced ventroapically, moderately concave mesally; furcula and supra-anal plate about as in figure 64, *m*, of *cochisei*; epiphallus as in *poecilus*; dorsal valves of aedeagus broad, narrowing but little at base, contiguous apically (fig. 64, *f*).

*Coloration*: All the material examined was originally preserved in alcohol, so that discoloration has occurred. The pattern is the same as that of related species, except that the postocular black bar is unbroken on the prozona of the lateral lobes of the pronotum, and there is a trace of the bar on the metazona. A diffusion of dark pigment may have occurred while immersed in fluid, and these distinctions may not be typical of fresh specimens.

*Measurements* (length in millimeters) of a topotype: Body, 26.5; pronotum, 6.3; front femur, 5.7; hind femur, 16.8.

*Female*.—As in male except for genital features and greater robustness.

*Measurements* (length in millimeters) of a topotype: Body, 30; pronotum, 7.5; front femur, 5.5; hind femur, 19.5; tegmen, 5.8. Body length of females examined varies from 30 to 40 mm., pronotal length from 7.5 to 8.5.

*Type*.—A unique male noted by Scudder (1897); also by Rehn and Hebard (1912). In Academy of Natural Sciences of Philadelphia.

*Type locality*.—San José del Cabo, Baja California.

In addition to the type, I have examined two males and two females labeled as topotypes and marked "taken with type." Like the type, they bear the locality label "San José del Cabo, Baja California. G. Eisen Coll." The type also bears a "drawn" label, showing that it was illustrated by Scudder. One additional male, three females, and three nymphs bear identical locality labels but are not marked as topotypes. The topotype labels were probably affixed in recent years by Mr. Hebard, and probably the whole series is equally deserving of topotypic designation. Although no collecting date is carried by these specimens, it is known that Gustavus A. Eisen collected in Baja California during the years 1892-'94.

Also preserved in the Academy of Natural Sciences of Philadelphia is the female allotype of *Melanoplus nitidus* Scudder, collected by John Xantus at Cape St. Lucas, Baja California. That species has been referred to *Sinaloa* by Hebard (1917), but he found that the type and allotype were not congeneric, even as Scudder himself had suspected. The entire available series of *crassus* was originally preserved in alcohol.

It is possible that *crassus* is rather localized, and perhaps seldom abundant as well, because a collection of Orthoptera from Baja California made in 1938 by E. S. Ross, of the California Academy of Sciences, does not contain it. Neither is it mentioned by Hebard (Proc. California Acad. Sci., ser. 4, vol. 12, pp. 319-340, 1923; Trans. Amer. Ent. Soc., vol. 57, pp. 113-127, 1931) in reporting two other collections from Baja California.

The southern tip of Baja California is characterized by scrub vegetation and belongs to the Tropical Zone. Readers are referred to Nelson (Mem. Nat. Acad. Sci., vol. 16, 194 pp., 35 pls., 1921) for a detailed scientific report on the biological characteristics of Baja California. A popular account is by Gardner (Holiday, vol. 3, No. 4, p. 62 and various subsequent pages, 1948).







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## FLEAS FROM THE UPPER SONORAN ZONE NEAR ALBUQUERQUE, N. MEX.

By LELIA ANN WILLIAMS and C. CLAYTON HOFF

DURING 1948 and 1949 a study was made of the fleas of some common rodents and rodent nests taken in the vicinity of Albuquerque, N. Mex. The more than 140 rodents examined included the large spotted ground squirrel [*Citellus spilosoma major* (Merriam)], kangaroo rats (*Dipodomys* spp.), grasshopper mice [*Onychomys leucogaster* (Wied)], and deer mice (*Peromyscus maniculatus* (Wagner)], obtained from the mixed grassland association found in the lower portion of the Upper Sonoran Zone, and the hoary woodrat (*Neotoma micropus canescens* Allen) and Say's rock squirrel [*Citellus variegatus grammurus* (Say)], found chiefly in the pinyon-juniper association or the upper portion of the Upper Sonoran Zone. As reported previously (Hoff and Williams, 1949), the nests examined were of the kangaroo rat (*Dipodomys spectabilis* Merriam) and the hoary woodrat mentioned above. The junior author is continuing the study to include the fleas of rodents found in biotic associations at higher elevations in the mountains near Albuquerque, N. Mex.

The junior author was largely responsible for the collection of rodents and nests,<sup>1</sup> although Ferd Sumrell and Dewitt Ivey aided in this work. The junior author also assumed responsibility for the final preparation of the drawings and the manuscript for publication, as well as for general supervision of the study. The senior

<sup>1</sup> The incidental field work was aided financially by a faculty research grant to the junior author from the University of New Mexico.

author prepared the fleas for study, made the identifications, wrote the descriptions of new species, and prepared drafts of the figures. The writers are deeply appreciative of the aid given by Maj. Robert Traub, of the Army Medical Center, Washington, D. C., and more especially of the help given by Dr. Frank M. Prince, of the Plague Suppressive Measures Laboratory, San Francisco, Calif. With exception of *Meringis dipodomys* Kohls (1938), Dr. Prince checked the identifications of representatives of all species recorded in the present paper. The specific determination of *M. dipodomys* was made by Major Traub.

During the course of this study two new species of fleas were discovered. These are described herein. In addition, nine species are reported for the first time from the State of New Mexico, and numerous other species are reported for the first time from the vicinity of Albuquerque. The present paper brings to a total of 34 the species and subspecies of fleas known from the State. With few exceptions the classification and nomenclature used here follow so closely the work of Hubbard (1947) that synonymies have been for the most part omitted. The species in the body of the present paper are systematically arranged in the order given by Hubbard.

The specimens upon which this study is based have been distributed to interested institutions, including the United States National Museum, the Texas State Department of Public Health, the Army Medical Center in Washington, the Plague Suppressive Measures Laboratory in San Francisco, and the Microbiological Institute of the Rocky Mountain Laboratory of the United States Public Health Service, in Hamilton, Mont. The holotypes and allotypes of new species have been deposited in the United States National Museum.

### Family HECTOPSYLLIDAE Baker, 1904

#### ECHIDNOPHAGA GALLINACEA (Westwood, 1875)

This species was taken from *Citellus variegatus grammurus* at Juan Tabo Recreation Area, 15 miles northeast of Albuquerque, on June 26, 1948; from *Citellus spilosoma major*, taken 2 miles north and northwest of the University of New Mexico campus on a number of occasions; and from *Onychomys leucogaster*, taken a short distance east of Albuquerque, on September 25, 1948.

### Family PULICIDAE Stephens, 1829

#### HOPLOPSYLLUS ANOMALUS (Baker, 1904)

This species was found on *Citellus variegatus grammurus*, taken at the Juan Tabo Recreation Area, about 15 miles northeast of Albuquerque, on June 26, 1948.

## ANOMIOPSYLLUS NOVOMEXICANENSIS, new species

FIGURE 66, a-d

Head: Frontal tubercle present, head apically angulate; in the male, dorsal margin of head somewhat flattened or depressed between the tubercle and cervicum. Genal armature of two slender bristles, one at the edge of antennal groove and the other near the midventral margin of the gena, with a short and very weak seta midway between the two. Postantennal region nude with exception of small setae at lower marginal angle. Bristles of the second antennal segment short in both sexes. The antenna of the male long and slender, shorter and stouter in the female. Labial palpi extending to about the distal margin of the forecoxae or slightly beyond; maxillary palpi often slightly longer.

Thorax: As in the genus.

Legs: Each of coxa II and III with a posterodistal spinelike lobe separated from coxa proper by a deep incision. Coxa III without a row or patch of spinelets on inner surface. Segment 5 of tarsi I and II with five pairs of plantar bristles, the proximal pair being situated medially between the bristles of the next two pairs or more nearly between the bristles of the second pair; fifth segment of tarsus III with only four pairs of plantar bristles, all lateral and forming two parallel rows.

Abdomen: Two anterior tergites usually with a few apical spinelets, in a few instances only on the first tergite; all tergites with a single row of weak setae. One well-developed antepygidial bristle on each side.

Modified segments, male: Sternite IX (fig. 66, a) of male bearing two black spiniforms near the tip and slightly proximal a longer and clear spiniform. Finger (fig. 66, b) subtriangular, wide at base and becoming narrow at tip; position of setae as in the figure; with three black spiniforms subevenly spaced near the posterior border. Process of clasper lobelike, directed dorsally, the posterior border rounded and with three setae.

Modified segments, female: Sternite VII as shown in figure 66, c. Spermatheca (fig. 66, d) has a rounded body and a crooked tail. Stylet about three times longer than wide, with one long bristle and two very short apical setae.

*Types*.—Holotype, allotype, and paratypes, U.S.N.M. No. 59336.

*Type locality*.—Six miles east of Albuquerque, at west foothills of Sandia Mountains, Bernalillo County, N. Mex. Male holotype, female allotype, 332 male paratypes, and 605 female paratypes from nests of the hoary woodrat (*Neotoma micropus canescens* Allen) collected on October 10, 1948; from nests of the same rodent, 62 male paratypes, and 126 female paratypes on February

28, 1948; and 16 male paratypes and 4 female paratypes from both a nest and animals collected in December 1947.

*Remarks.*—The known species of *Anomiopsyllus* Baker fall into two natural groupings. One of the groups includes forms with two spiniforms on the movable finger of the clasper and the second



FIGURE 66.—a-d, *Anomiopsyllus novomexicanensis*, new species: a, Sternite IX of male holotype; b, finger and process of clasper, male holotype; c, sternite VII of female allotype; d, spermatheca of female allotype. e-g, *Megarthroglossus bisetis* Jordan and Rothschild: e, Sternite IX of male, three bristles on posterior margin; f, sternite IX of male, five bristles on the posterior margin; g, finger of clasper of male. h-j, *Meringis nidi*, new species: h, Sternite IX of male holotype; i, finger and process of clasper, male paratype; j, spermatheca of female allotype.



group includes species in which there are three spiniforms on the finger. Our form belongs in the second group and appears to be closely related to *A. hiemalis* Eads and Menzies, 1948, from Texas. In *hiemalis* the three spiniforms are subequally spaced along nearly the entire posterior border, while in our new species the spiniforms are more equally spaced and confined to about the distal half of the finger. In addition, in *hiemalis* there are a few bristles in a row between the central and basal spiniforms of the finger while in *novomexicanensis* no bristles occur between these two spiniforms.

### Family DOLICHOPSYLLIDAE Baker, 1905

#### ORCHOPEAS SEXDENTATUS (Baker, 1904), subspecies undetermined

Difficulties incident to the determination of subspecies in this species and the great variation that is observed in the lot of specimens at hand preclude subspecies determination at this time. The males in this collection usually have four spiniforms equally spaced on the posterior border and one above, although rarely there are only three equally spaced spiniforms on the posterior border and one above. Sternite IX of the male has one black spiniform and three bristles. In the female the apical outline of sternite VII is variable. Of the two lobes, there is a large amount of variation in the upper lobe. In some females the upper lobe may be longer than the lower lobe and the upper lobe may be pointed or rounded at the tip. The spermatheca is typically that of the species with the body barrel-shaped and with a crooked tail. Records of this undetermined subspecies include specimens taken from *Neotoma micropus canescens*, captured along the Rio Puerco near the U. S. Route 66 bridge and about 18 miles west of Albuquerque, on February 28, 1948, specimens from the same host, as well as a nest taken from the foothills of the Sandia Mountains, 5 miles east of Albuquerque, in December 1947, and from other nests taken in the same location on October 10, 1948.

#### THRASSIS PANSUS (Jordan, 1925)

Dr. Frank M. Prince, in litt., informs us that in the lot of our specimens examined by him the parameres are shaped differently from those in specimens from Cochise County, Arizona (type locality). However, he considers our specimens to be of this species. *Thrassis pansus* has been taken by us from *Onychomys leucogaster*, captured on the grassland a few miles east of Albuquerque, September 25, 1948, and has been removed in large numbers from *Citellus spilosoma major*, captured on various dates on the University of New Mexico golf course and within a few miles north

and east of Albuquerque. We also have one specimen from *C. s. major* trapped just west of the Rio Grande near Bernalillo, N. Mex., on February 21, 1948.

THRASSIS CAMPESTRIS Prince, 1944

*Thrassoides campestris* (Prince, 1944) HUBBARD, 1947, p. 146.

This form has been taken from *Dipodomys ordii* (Woodhouse), collected near the U. S. Route 66 bridge over the Rio Puerco and about 18 miles west of Albuquerque, on February 28, 1949, and from nesting materials and food storage of *Dipodomys spectabilis*, taken just east of Albuquerque, on March 6, 1948.

DIAMANUS MONTANUS (Baker, 1895)

This flea was found on *Citellus variegatus grammurus*, taken at the Juan Tabo Recreation Area, about 15 miles northeast of Albuquerque, on June 26, 1948.

(?) MALARAEUS SINOMUS (Jordan, 1925)

Since no males are present in the collection certain separation cannot be made between *M. sinomus* (Jordan, 1925) and *M. eremicus* (Baker, 1904). Two females have been taken from *Peromyscus maniculatus*, collected just west of the Rio Grande, near Bernalillo, N. Mex., on March 12, 1948.

MONOPSYLLUS WAGNERI (Baker, 1904), subspecies undetermined

A subspecific determination based entirely on females is so uncertain that none has been attempted. Five females were taken from *Peromyscus maniculatus*, collected just west of the Rio Grande, near Bernalillo, N. Mex., on March 12, 1948.

Family HYSTRICHOPSYLLIDAE Tiraboschi, 1904

ATYPHLOCERAS ECHIS Jordan and Rothschild, 1915

Numerous fleas of this species have been taken from an animal and a nest of *Neotoma micropus canescens*, collected near the base of the Sandia Mountains, about 5 miles east of Albuquerque, during December 1947.

MEGARTHROGLOSSUS BISETIS Jordan and Rothschild, 1915

FIGURE 66, c-g

Hubbard (1947) reduces this species to a subspecies of *M. divisus* (Baker, 1898). A short description is given here of the previously undescribed male.

Head: One row of four bristles on gena, short ones alternating with very long ones (these bristles are not always in a straight row), also a few small bristles above this row. Postantennal region

with a very strong bristle near the posterior angle, a smaller one in the occipital region, and a few very small setae, especially along the posterior margin of the antennal groove. The antenna of the male much longer and relatively more slender than that of the female. Labial palpus of five segments, the ultimate one very long, slightly curved, apex produced more posteriorly than anteriorly. Labial palpi extending beyond tip of trochanter I, often nearly to the distal end of femur I.

Thorax: Pronotal comb usually composed of 16 teeth.

Legs: As for the genus; mid- and hind-femora with a medial row of bristles; tibiae without medial bristles. Fifth segment in all tarsi with a proximal ventral pair and four lateral pairs of plantar bristles.

Abdomen: As described for the genus; with a few apical spinelets on anterior tergites; abdominal tergites with but one row of bristles. The males have a single antepygidial bristle on each side.

Modified segments: Sternite IX (fig. 66, *e*, *f*) broad at base, narrowed at apex, curving upward and bearing near the center of the curved posterior edge three to five, usually four, bristles, the anterior edge and apex with small setae. Finger (fig. 66, *g*) slightly convex on both anterior and posterior borders, roughly subcylindrical, apex rounded; with a few setae along the margins. Process with usually three long setae and a few shorter setae on the posterior border.

*Records.*—Our records include one male specimen from *Peromyscus maniculatus*, collected just west of the Rio Grande, near Bernalillo, on March 12, 1948, and many specimens obtained on numerous occasions from the nests and animals of *Neotoma micropus canescens*, taken a few miles east of Albuquerque, at the foot of the Sandia Mountains.

#### EPITEDIA STANFORDI Traub, 1944

A single female was taken from a nest of *Neotoma micropus canescens*, near the Sandia Mountains, about 5 miles east of Albuquerque, in December 1947.

#### MERINGIS DIPODOMYS Kohls, 1938

Our records include two males taken from *Dipodomys ordii*, collected just west of the Rio Grande, near Bernalillo, on February 21, 1948.

#### MERINGIS PARKERI Jordan, 1937

Specimens were taken from *Neotoma micropus canescens*, captured near the U. S. Route 66 bridge over the Rio Puerco and about 18 miles west of Albuquerque, on February 28, 1948, and

from the same species of host and nest collected in the foothills of the Sandia Mountains, about 6 miles east of Albuquerque, in December 1947; other specimens were taken from *Onychomys leucogaster melanophrys* Merriam, collected just west of the Rio Grande, near Bernalillo, on March 12, 1948.

MERINGIS NIDI, new species

FIGURE 66, *h-j*

Head: Much as outlined for the genus by Hubbard (1947). Two rows of bristles present on gena, upper row of three or four medium-sized ones and a lower row of four heavy ones, two extending slightly beyond the genal teeth.

Thorax: As for the genus.

Legs: Coxa III with a row of spinelets on inner surface. Tarsal segment 5 of each leg with four pairs of lateral plantar bristles and a basal, submedian, ventral pair.

Abdomen: Tergal chaetotaxy as usual for the genus. Three antepygidial bristles on each side; of these the dorsal is the shortest, the middle one the longest, and the ventral is subequal to the middle bristle and twice the length of the dorsal or shortest bristle.

Modified segments, male: Sternite IX (fig. 66, *h*) with two, rarely three, black spiniforms on the posterior border near the apex; the dorsal spiniform is the shorter. Along the margin of the sternite proximal to the spiniforms occur some setae; at the apex formed by the juncture of the anterior and distal margins, there is located a small clear spiniform. Finger (fig. 66, *i*) is armed on the posterior border with numerous setae; apex somewhat flattened; anterior border of finger somewhat concave near the apex.

Modified segments, female: Sternite VII with a broadly undulating posterior margin, showing considerable variation. Spermatheca (fig. 66, *j*) with body subcylindrical, somewhat constricted near the middle; tail well bent.

*Types*.—Holotype, allotype, and paratypes, U.S.N.M. No. 59337.

*Type locality*.—Five miles east of Albuquerque, N. Mex. Male holotype, female allotype, 27 male paratypes, and 69 female paratypes from a nest of a kangaroo rat (*Dipodomys spectabilis*) collected on March 6, 1948, and three male paratypes and eight female paratypes from the food storage associated with the same nest.

*Remarks*.—This new species is near *M. dipodomys* Kohls, 1938, but the male can be separated by the heavier sternite IX and the different arrangement of spiniforms in *nidi*. Also in *M. nidi* the finger is much less regular in outline than it is in *dipodomys*.



## MERINGIS, species undetermined

Since the collection contains only females, certain specific identification is not practical. The specimens were taken from *Onychomys leucogaster melanophrys*, just west of the Rio Grande, near Bernalillo, on March 12, 1948.

## PEROMYSCOPSYLLA HESPEROMYS (Baker, 1904)

Two specimens were taken from *Peromyscus maniculatus*, captured just west of the Rio Grande, opposite Bernalillo, on March 12, 1948.

## PHALACROPSYLLA ALLOS Wagner, 1936

We have a record of this flea from *Peromyscus maniculatus*, taken west of the Rio Grande, near Bernalillo, on March 12, 1948.

## STENOPONIA AMERICANA (Baker, 1899)

In our collection there is a record of this flea from *Peromyscus nasutus* (Allen), collected in the Jemez Mountains, about 70 miles north of Albuquerque, on March 27, 1948.

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SOME DIGENETIC TREMATODES, INCLUDING EIGHT  
NEW SPECIES, FROM MARINE FISHES OF  
LA JOLLA, CALIF.<sup>1</sup>

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By HAROLD W. MANTER and HARLEY J. VAN CLEAVE

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IN April and May, 1940, one of us (Van Cleave) carried on a preliminary investigation of the worm parasites of marine fishes of southern California. The Scripps Institution of Oceanography, through its director, Dr. H. U. Sverdrup, very generously provided facilities, and Dr. Denis Fox extended privileges of his laboratory, while Percy Barnhart aided in the collection and identification of the fishes. In the vicinity of La Jolla approximately 200 individual fishes were examined, representing 34 species. Two papers have been published previously on the Acanthocephala encountered (Van Cleave, 1940, 1945), and another is in preparation. The present report is based wholly upon the digenetic trematodes recovered from 16 species of fishes, but in some instances the trematodes were either immature or so few as to render identification impossible. Several of the hosts from which no trematodes were taken were represented by one or a very few autopsies; consequently for these hosts the negative records are without significance. More extensive sampling would be needed before a faunal list approaching completeness could be presented.

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<sup>1</sup>Studies from the Department of Zoology, University of Nebraska, No. 249; Studies from the Department of Zoology, University of Illinois; and Contributions from the Scripps Institute of Oceanography, new series, No. 482.

The writers are especially indebted to Mrs. Jean A. Ross for staining and mounting the specimens, to Mrs. Katharine Hill Paul for most of the drawings that illustrate this report, and to Dr. Carl L. Hubbs for checking the names of the fish hosts.

All hosts are from the vicinity of La Jolla in southern California unless other localities are cited. All the croakers and corbinas (family Sciaenidae) were taken by line fishing from the Scripps Laboratory pier at La Jolla. Most of the other fishes were collected by seining in shallow waters and tide pools or were obtained from commercial fishermen.

In this study 17 species of digenetic trematodes are recognized from marine fishes, of which 8 are regarded as previously undescribed. In the collections available for study there are unsatisfactory representatives of two additional species, but the material is not adequate to serve as the basis for describing these as new species. One is a species of the genus *Phyllodistomum* (family Gorgoderidae) from *Fundulus parvipinnis parvipinnis* Girard, and the other is an undescribed species of the genus *Lepidapedon* (family Lepocreadiidae) from *Mycteroperca pardalis* Gilbert, from Mazatlán, Gulf of California. The former is represented by a single individual and the latter by two broken specimens, both of which lack the anterior extremity including the oral sucker. We prefer to withhold descriptions of these in the hope that some other worker may discover more adequate material on which to base the species.

For each new species described in this report a holotype has been designated and is deposited in the United States National Museum as a stained whole mount in clarite. All additional specimens of the new species are regarded as paratypes, and as far as available these are deposited in our own collections at Lincoln, Nebr., and Urbana, Ill., respectively, and in the United States National Museum.

A total of nine families of digenetic trematodes are represented in the collection under consideration, of which the family Opecoelidae had the widest representation of genera and species as well as of individual specimens. In the text descriptions are arranged by families of the trematodes. A list of fish hosts, with the trematodes encountered in each, is given on pages 336-337.

Previously there have been few studies of trematodes of fishes from the Pacific coast of this continent. Chief of these are the publications of Lloyd, McFarlane, Noble, Annereaux, and Park, while Manter (1940) has described a few species from the Mexican coast. The trematode fauna of southern California has been but little known. Sleggs (1927) reported *Otodistomum cestoides*

(= *Distomum veliporum* of Sleggs) from *Raja bituberculata*<sup>2</sup> at La Jolla, and a hemiurid, which he called *Distomum appendiculatum*, from *Paralichthys californicus*, presumably also from La Jolla. This latter species is too incompletely described to permit of its identification. In the present study an immature hemiurid from the same host could not be identified as to genus.

## Order GASTEROSTOMATA

### Family BUCEPHALIDAE

#### Genus BUCEPHALOPSIS Baer, 1855

#### BUCEPHALOPSIS LABIATUS, new species

#### PLATE 12, FIGURES 1, 2

*Description* (measurements based on nine specimens).—Small, ovoid gasterostomes, 0.635 to 0.745 mm. long by 0.234 to 0.328 mm. wide, widest near anterior end. Anterior sucker (as) 0.127 to 0.146 mm. in transverse diameter. Mouth posterior to midbody, usually about two-thirds body length from anterior end, with a conspicuous anterior oral lobe or lip (ol). Pharynx (ph) ovoid, wider than long, 0.071 to 0.080 mm. in transverse diameter; esophagus extending anteriorly, gradually widening to become the cecum (ic), which curves backward from near posterior edge of ovary so that the digestive system is inverted U-shaped, ending slightly anterior to level of the mouth. Testes (t) ovoid, diagonal; anterior testis approximately at midbody level and mostly anterior to mouth. Cirrus sac (cs) long and slender, almost uniform in width, extending anterior to mouth to midbody or beyond; 0.314 to 0.360 mm. long by 0.066 to 0.073 mm. wide; seminal vesicle an ovoid sac 0.076 to 0.078 mm. long by 0.046 to 0.070 mm. wide; atrial tube moderately long, 0.060 to 0.087 mm.; genital pore ventral, near posterior end of body. Ovary (ov) globular, immediately anterior to anterior testis; vitelline follicles (v) fused to form two irregular longitudinal masses at ovarian level, meeting near anterior end of ovary, diverging slightly posteriorly, usually seeming to be displaced toward one side of the body; vitelline duct from each mass extends posteriorly to meet near intertestis level and some distance posterior to ovary; uterus (ut) extends anteriorly near right edge of body from near union of yolk ducts, reaching to anterior sucker, extending posteriorly to right of ovary, a short metraterm leads to the genital atrium (ga). Uncollapsed and normal eggs 25 to 31 $\mu$  by 16 to 17 $\mu$ . Excretory pore terminal; excretory vesicle (ex) extending to near base of anterior sucker.

<sup>2</sup> Probably a lapsus calami for *Raja binoculata*.

*Host*.—*Paralichthys californicus* (Ayres), California halibut.

*Location*.—Intestine.

*Types*.—Holotypes and paratypes, U.S.N.M. Helm. Coll. No. 37142.

*Discussion*.—The name *labiatus* is from *labium*, lip, and refers to the preoral lip (ol, pl. 12, figs. 1, 2), which is not present in any other species in the genus. Uncommon features are the posterior location of the mouth, the reduced and contiguous vitellaria, the long excretory vesicle, the curved cecum, and the long cirrus sac. The species most similar to *B. labiatus* seems to be *B. karvei* Bhalerao, 1937, from *Belone* in the Indian Ocean. The two species agree in small body size, mouth posterior to midbody, and cirrus sac reaching anterior to midbody; but differ in that *B. karvei* has vitellaria in two widely separated groups, does not have a recurved cecum, lacks the preoral lip, and has smaller eggs. *B. magnacetabulum* Nagaty, 1937, from *Belone choram*, in the Red Sea, resembles and differs from *B. labiatus* in the same respects except that its cirrus sac is relatively shorter. It may be found that *B. karvei* and *B. magnacetabulum* are a single species.

The occurrence in Belonidae of species of trematodes apparently most similar to a species occurring in sinistral flat fishes (Bothidae) suggests the host distribution of the species of *Steganoderma* (Manter, 1947, p. 312). Neither the ecology nor the phylogeny of these families of fishes indicates any relationship that would be suggested by their trematode parasites.

## Order PROSOSTOMATA

### Family OPECOELIDAE

#### Genus OPECOELUS Ozaki, 1925

#### OPECOELUS ADSPHAERICUS, new species

#### PLATE 12, FIGURES 3-5

*Description* (based on about 60 specimens with measurements on 7 individuals selected for size range).—Body elongate, cylindrical, smooth, 1.336 to 4.004 mm. long by 0.167 to 0.409 mm. in greatest width. Oral sucker 0.084 to 0.146 in diameter; acetabulum 0.112 to 0.255 mm. in diameter. Sucker ratio 1:1.33 to 1.66. Acetabulum protuberant; with three pairs of short, rather inconspicuous, lobelike, simple papillae (ap, pl. 12, fig. 4), barely discernible when retracted. Often only lateral views of the suckers are presented; measurements of depths rather than transverse diameters give similar sucker ratio. Forebody 0.197 to 0.511 mm. or about one-fifth to one-eighth body length. Posttesticular



distance 0.380 to 1.219 mm. or about one-third to one-fourth body length and about twice length of forebody. Prepharynx short; pharynx 0.051 to 0.095 mm. long by 0.051 to 0.102 mm. wide; esophagus 0.119 to 0.153 mm. long or about  $1\frac{1}{2}$  times length of pharynx; intestinal bifurcation near anterior edge of acetabulum; ceca uniting and opening through a ventral anus (a, fig. 3) slightly anterior to posterior end of body.

Genital pore slightly to the left, opposite anterior half of esophagus, varying from near base of pharynx to about midesophageal level. Testes rounded to elongate, smooth, tandem, almost always separated by vitellaria (only one apparent exception); anterior testis about at midbody level. Cirrus sac (cs, fig. 5) elongate pyriform, 0.102 to 0.110 mm. long in medium-sized specimens, mostly anterior to intestinal bifurcation, containing a short cirrus (cir), a tubular prostatic vesicle, and a few inconspicuous gland cells (fig. 5) surrounding male tube immediately outside cirrus sac; seminal vesicle (sv) external, tubular, sinuous, extending a short distance posterior to acetabulum. Ovary indistinctly 3-lobed; seminal receptacle lacking; uterus preovarian; eggs 49 to 59 by 25 to  $38\mu$ ; uncollapsed eggs near ovary 49 to  $59\mu$  by 32 to  $38\mu$ ; collapsed eggs 51 to  $56\mu$  by 25 to  $32\mu$ . Anterior extent of vitelline follicles varying from base of cirrus sac to posterior edge of acetabulum; follicles almost always interrupted opposite one or both testes and usually opposite ovary, almost always confluent between testes and usually between ovary and anterior testis, filling post-testicular space. The vitelline follicles are unusually variable in this species. Excretory pore terminal; excretory vesicle extending to near ovary.

*Hosts*.—*Clinocottus analis australis* Hubbs, tide-pool woolly sculpin; *Girella nigricans* (Ayres), the common opaleye.

*Location*.—Intestine.

*Types*.—Holotype and paratype, U.S.N.M. Helm. Coll. No. 37143.

*Discussion*.—The following 12 species of *Opecoelus* have been named: *elongatus* Ozaki, 1925; *gonistii* Yamaguti, 1938; *inimici* Yamaguti, 1934; *lobatus* Ozaki, 1925; *mexicanus* Manter, 1940; *minor* Yamaguti, 1934; *mutu* Yamaguti, 1940; *ozakii* (Layman, 1930) Yamaguti, 1938; *quadratus* Ozaki, 1928; *sebastodis* Yamaguti, 1934; *sphaericus* Ozaki, 1925 (type species); *xenistii* Manter, 1940.

Of these species, three (*sphaericus*, *minor*, and *sebastodis*) are extremely similar. Yamaguti himself (1934) confused *O. minor* and *O. sebastodis*, finally deciding (1940) that the latter differed from the former only in shorter acetabular papillae and larger

eggs (54 to 65 $\mu$  by 30 to 38 $\mu$  for *minor* as compared with 63 to 75 $\mu$  by 40 to 45 $\mu$  for *sebastodis*). He expressed the view that egg measurements differed considerably between living and preserved specimens, yet most descriptions do not indicate whether measurements are made on living or fixed material. Also, it seems unusual that Yamaguti should claim considerably larger egg sizes for preserved material as compared with living. Actually, his living egg sizes for *O. minor* agree well with measurements on two preserved specimens of *O. minor* sent to one of us (Manter) by Yamaguti several years ago. Thus, *O. minor* can be distinguished from *O. sphaericus* by its longer acetabular papillae and smaller eggs (72 to 81 $\mu$  by 41 to 47 $\mu$  for *sphaericus*). The rather small specimens from a "black eel" reported as "probably" *O. sphaericus* by Yamaguti (1940 p. 73) would seem to be doubtfully that species. Their sucker ratio and egg sizes are much more like *O. minor*.

The corrections by Yamaguti mentioned above make *O. sebastodis* more like *O. sphaericus*. Egg sizes agree as well as body proportions. The only difference discernible from descriptions is one of body size (1.6 to 3.4 mm. length for *sebastodis*, 4.3 to 8.25 mm. for *sphaericus*). Until and unless further constant differences can be found, *O. sebastodis* should be considered a synonym of *O. sphaericus*.

*Opecoelus adsphaericus* differs from *O. minor* only in having short, inconspicuous acetabular papillae and a more anterior genital pore. Even when the acetabulum is greatly extended the papillae are usually very short in *O. adsphaericus*. In only 3 specimens of more than 60 did the papillae seem to be at maximum extension measuring up to 0.036 mm. in length. In two specimens of *O. minor* available for study, each of which was almost exactly the size of the above specimens of *O. adsphaericus*, the papillae measured 0.050 and 0.072 mm., while Yamaguti states they reach 0.118 mm. His figure shows them about as long as the depth of the acetabulum itself, a condition never approached in *O. adsphaericus*. Also, in *O. minor* the papillae have a thick outer layer of cuticula. The two species agree in shape and location of reproductive organs and in egg size. Sucker ratios are difficult to compare, as Yamaguti's original figures indicate a ratio of 1:1.8 for *O. minor* but his fig. 46 (1934), which he later (1940) claimed to be *O. minor* rather than *O. sebastodis* as labeled, shows a ratio of more than 1:2. We do not feel it possible to identify our specimens as *O. sphaericus* (= *O. sebastodis*) because of two differences: *O. adsphaericus* has a genital pore opposite the anterior half of the esophagus and an egg size of 49 to 59 $\mu$  by 26 to 24 $\mu$  (as compared with 72 to 81 $\mu$  by 44 to 47 $\mu$ ). Our specimens are consider-

ably smaller than the sizes originally given for *O. sphaericus* but not smaller than *O. Sebastodis*. Unfortunately, in *O. adsphaericus* the extent of the vitelline follicles is unreliable as a diagnostic aid, since both their anterior extent and their interruption opposite the testes varied in our material. However, in *O. adsphaericus* the follicles are almost always interrupted opposite the testes, whereas Ozaki states (1928, p. 12) that in *O. sphaericus* they are usually continuous but may be discontinuous opposite the gonads.

A series of 11 specimens of *Opecoelus* from the intestine of *Girella nigricans* (Ayres) showed some fairly consistent differences from those taken from *Clinocottus*. In individuals from *Girella* the pharynx was often somewhat larger, with reference to diameter of the oral sucker, than was typical for individuals from *Clinocottus*; likewise the eggs averaged larger, and the oral papillae were in some instances longer and more pointed. However, in some individuals from *Girella*, measurements of these details fell distinctly within the range established for the series from *Clinocottus*. Consequently it seems admissible to identify the specimens from *Girella* as *Opecoelus adsphaericus* and in so doing to recognize considerable individual variability within this species.

The name *adsphaericus* indicates the similarity of the species to *O. sphaericus*.

Related genera occur in the Atlantic, but as yet the genus *Opecoelus* is reported only from Japanese waters and from the American Pacific coast.

#### Genus PSEUDOPECOELUS von Wicklen, 1946

##### PSEUDOPECOELUS GIBBONSAE, new species

##### PLATE 12, FIGURES 6, 7

*Description* (based on two specimens).—Body (pl. 12, fig. 6) rather thick, unspined, 2.262 to 2.558 mm. in length, 0.643 to 0.780 mm. in thickness at acetabular level. Oral sucker (os) 0.179 to 0.195 mm. in length; 0.187 to 0.195 mm. in thickness. Acetabulum (ac) slightly protuberant, without papillae; 0.421 to 0.468 mm. in length; 0.382 to 0.429 mm. in depth. Ratio of sucker lengths, 1:2.35 to 2.4. Acetabulum 0.773 to 0.811 mm. or about one-third body length from anterior end. Prepharynx 0.055 to 0.086 mm. in length. Pharynx (ph) large, 0.163 to 0.179 mm. long by 0.179 to 0.195 mm. thick. Esophagus frequently longer than pharynx, 0.269 mm. long in the 2.558 mm. specimen, in which the pharynx was 0.179 mm. long. Ceca (ic) ending blindly near posterior end of body. Genital pore (gp) ventral, slightly to the left, opposite posterior fourth of pharynx; accessory suckers lacking. Testes (t) smooth, sub-spherical, tandem, contiguous, in midregion of hindbody; post-

testicular space 0.523 to 0.577 mm. Seminal vesicle (sv) a relatively narrow sinuous tube extending from near the genital pore posterior to acetabulum almost to ovary; cirrus very short; cirrus sac lacking; a few gland cells (pl. 12, fig. 7) in region of genital pore. Ovary globular, smooth, immediately pretesticular, slightly to the right; seminal receptacle lacking; sperm cells in uterus; Mehlis' gland very large and conspicuous; vitelline follicles (v) large, extending from a point about midway between pharynx and acetabulum continuously to posterior end of body, surrounding the ceca. Uterus preovarian; metraterm lacking; eggs 90 to  $92\mu$  by 36 to  $47\mu$ , when uncollapsed 90 to  $92\mu$  by 43 to  $47\mu$ . Excretory vesicle extending to posterior edge of ovary.

*Host*.—*Gibbonsia metzi* Hubbs, weed sawfish.

*Location*.—Intestine.

*Holotype*.—U.S.N.M. Helm. Coll. No. 37145.

*Discussion*.—The genus *Pseudopecoelus* contains the following species: *vulgaris* (Manter, 1934) Von Wicklen, 1946; *japonicus* (Yamaguti, 1938) Von Wicklen, 1946; *elongatus* (Yamaguti, 1938) Von Wicklen, 1946; *tortugae* Von Wicklen, 1946; *priacanthi* (MacCallum, 1916) Manter, 1947. *P. gibbonsiae* differs from all these in that its vitellaria extend anterior to the acetabulum. *P. vulgaris* and *P. japonicus* have a lobed ovary. *P. elongatus* has a more posterior genital pore and smaller eggs, and its vitellaria are interrupted opposite the gonads. *P. tortugae* has a more posterior genital pore, much longer hindbody and uterus, and smaller eggs. *P. priacanthi* has a different sucker ratio and much smaller eggs.

PSEUDOPECOELUS UMBRINAE, new species

PLATE 12, FIGURES 8, 9

*Description*.—This species has the generic characters of *Pseudopecoelus*, namely: smooth body; acetabulum without papillae; no accessory sucker; ceca ending blindly; no cirrus sac; short cirrus; and tubular seminal vesicle. Length 1.037 to 2.420 mm.; greatest width (near posterior end or at acetabular region) 0.460 to 0.873 mm. Body tapering from acetabular level to anterior end, broadly rounded posteriorly. Forebody 0.292 to 0.584 mm. in length or approximately one-fourth body length; a little greater or a little less than posttesticular space. Oral sucker 0.124 to 0.190 mm. in transverse diameter; acetabulum 0.219 to 0.365 mm. in transverse diameter, slightly wider than long, with transverse aperture. Sucker ratio 1:1.65 to 2. Acetabulum usually slightly



less than twice the diameter of oral sucker. Prepharynx short; pharynx 0.061 to 0.095 mm. in length by 0.075 to 0.124 mm. in width; length of esophagus one to two times length of pharynx; intestinal bifurcation a short distance anterior to acetabulum; ceca ending blindly a short distance anterior to posterior end of body.

Genital pore (gp, pl. 12, figs. 8, 9) muscular, slightly to left of midline at midpharyngeal level. Testes (t, pl. 12, fig. 8) large, tandem or slightly diagonal, close together, smooth or slightly irregular in outline. Posterior testis usually with a slightly indented outline. Cirrus (cir, fig. 9) very short; prostatic vesicle (pv) small and ovoid; seminal vesicle (sv) sinuous, somewhat more swollen posteriorly, extending dorsal to acetabulum to mid-acetabular level or to near posterior edge of acetabulum; cirrus sac lacking. Ovary 3- or 4-lobed (ov, fig. 8), partly to the right and partly anterior to anterior testis. Uterus beginning to left of ovary, mostly preovarian. Seminal receptacle and metraterm lacking. Vitelline follicles (v, fig. 8) large, extending from posterior end of esophagus to posterior end of body; lateral, dorsal, and ventral to ceca; anterior to acetabulum they are lateral and dorsal but only scantily dorsal to ceca; confluent posterior to testes; almost confluent anterior to acetabulum. Eggs 61 to 71 $\mu$  (rarely to 80 $\mu$ ) by 27 to 49 $\mu$ ; collapsed eggs 61 to 68 $\mu$  by 27 to 32 $\mu$ ; uncollapsed eggs near ovary and probably more nearly representing the size of living eggs, 68 to 71 $\mu$  by 42 to 49 $\mu$ . Excretory vesicle extending forward almost to ovary.

*Host*.—*Umbrina roncadore* Jordan and Gilbert, yellowfin croaker.

*Location*.—Intestine.

*Types*.—Holotype and paratype, U.S.N.M. Helm. Coll. No. 37146.

*Discussion*.—*P. umbrinae* differs from all species in the genus, except *P. gibbonsiae*, in that the vitellaria extend anterior to the acetabulum. It is the only species in which the seminal vesicle does not extend posterior to the acetabulum. The acetabulum is relatively larger than in *P. japonicus*, *P. elongatus*, or *P. tortugae*, and relatively smaller than in *P. vulgaris*. It differs from *P. gibbonsiae* in its lobed ovary, smaller pharynx, more flattened body, and much smaller eggs.

#### Genus HELICOMETRINA Linton, 1910

HELICOMETRINA ELONGATA Noble and Park, 1937

#### PLATE 13, FIGURE 10

*Hosts*.—*Clinocottus analis australis* Hubbs,<sup>3</sup> tide-pool woolly sculpin; *Gibbonsia elegans* (Cooper),<sup>3</sup> ocellated sawfish; *Gibbonsia metzi* Hubbs,<sup>3</sup> weed sawfish.

<sup>3</sup> New host record.

*Location*.—Intestine.

*Discussion*.—The previously recorded host for this species is *Sicyogaster maeandrica* (= *Caularchus maeandricus*), Bodega Bay, Calif.

This species is distinguished from *H. nimia* in that the vitelline follicles (v, pl. 13, fig. 10) are interrupted near the acetabulum, the genital pore is anterior to the intestinal bifurcation, and the ovary (ov) has four rather than three lobes. These distinctions held for all of about 37 specimens from *Gibbonsia* and almost all of 20 specimens from *Clinocottus*, although rarely the vitellaria were continuous on one side. Three specimens from *Clinocottus* confuse the picture somewhat. These have continuous vitellaria, a genital pore posterior to the bifurcation, and an ovary either with four lobes or with lobes too indistinct to count. Perhaps these specimens are *H. nimia*, which is already known to have a wide host and geographical distribution and has been reported from the Pacific (Galápagos Islands). However, numerous specimens of *H. nimia* from both Tortugas, Fla., and the Galápagos Islands agree in that the three or four primary lobes of the ovary are secondarily lobed and the testes are not rounded as in *H. elongata* but wider than long and irregular in outline, sometimes almost lobed. For the present it seems best to consider the round testes and the 4-lobed ovary as characters distinguishing *H. elongata* from *H. nimia*. However, a conspicuous interruption of the vitelline follicles and a more anterior genital pore seem to be at least almost always characteristic of *H. elongata* and perhaps never occur in *H. nimia*.

Genus GENITOCOTYLE Park, 1937

GENITOCOTYLE ACIRRATA Park, 1937

*Hosts*.—*Damalichthys vacca* Girard,<sup>3</sup> pileperch; *Umbrina roncadore* Jordan and Gilbert,<sup>3</sup> yellowfin croaker.

*Location*.—Intestine.

*Number*.—One in a single specimen of each host species.

*Discussion*.—A specimen of *G. acirrata* sent to one of us (Mantel) several years ago was available for comparison. It is believed that Park's so-called "pars prostatica" is actually a thick-walled cirrus with circular muscles especially conspicuous. Thus, the name given to the species is probably inappropriate.

This species is known previously only from *Holconotus rhodoterus* Agassiz, the porgy or surfperch, from Dillons Beach, Calif.

<sup>3</sup> New host record.

Genus *PLAGIOPORUS* Stafford, 1904*PLAGIOPORUS* ISAITSCHIKOWI (Layman, 1930) Yamaguti, 1938*Host*.—*Paralabrax clathratus* (Girard),<sup>3</sup> kelp bass.*Location*.—Intestine.

*Discussion*.—Three specimens, in only fair condition and showing only a lateral view, are identified as this species. They agree with Yamaguti's description in such characteristic details as vitellaria interrupted opposite acetabulum; testes tandem; genital pore opposite pharynx; uterus extending to posterior edge of anterior testis; ceca ending a little beyond posterior testis. However, the cirrus sac extends to a little past midacetabular level (rather than ending close to anterior border) and the largest eggs in utero were 48 by 34 $\mu$  as compared with 57 to 63 $\mu$  by 38 to 40 $\mu$  described for *P. isaitschikowi*. Contraction of the forebody might affect somewhat the posterior extent of the cirrus sac. The difference in egg size is considerable, but Yamaguti does not state whether his measurements were from preserved specimens. The sucker ratio on our specimens could not be determined because of the lateral view. *P. isaitschikowi* has been previously reported from *Sebastiscus albofasciatus*, from Suruga Bay, Japan, and from Peter the Great Bay.

Genus *OPECHONA* Looss, 1907*OPECHONA* ORIENTALIS (Layman, 1930) Ward and Fillingham, 1934

## PLATE 13, FIGURES 11, 12

*Host*.—*Girella nigricans* (Ayres),<sup>3</sup> common opaleye.*Location*.—Intestine.*Number*.—Several specimens, some immature.

*Discussion*.—These trematodes agree well with those reported from *Paranthias furcifer*, a "small mackerel," and *Angelichthys* sp., from the Mexican coast and the Galápagos Islands (Manter, 1940). A young specimen shows that the "branch of the excretory vesicle" on the left side of the body actually is represented on both sides (pl. 13, figs. 11, 12). When swollen, these lateral trunks or tubes (lt) are fairly conspicuous, extending from near the intestinal bifurcation to a short distance posterior to the testes where each seems to have an inconspicuous union with the excretory vesicle (ex, fig. 12). The median trunk of the excretory vesicle (mt) extends forward ventral to the intestinal bifurcation to end just posterior to the pharynx. It often contains round, deeply staining concretions. However, this median tube is separated by a narrow constriction from that portion of the vesicle posterior to

<sup>3</sup> New host record.

the testes (fig. 12), and thus may be homologous to the lateral excretory tubes. The lateral tubes do not occur in *Opechona pharyngodactyla*.

### Family ACANTHOCOLPIDAE

#### Genus STEPHANOSTOMUM Looss, 1899

*Stephanostomum* LOOSS, 1899, p. 576.

*Stephanochasmus* LOOSS, 1900, p. 603.

*Lechradena* LINTON, 1910, p. 46.

*Echinostephanus* YAMAGUTI, 1934, p. 374.

More than 30 species of *Stephanostomum* have been named. Of these, three—*Stephanochasmus hystrix* (Dupardin, 1845, of Olsson) Looss, 1899; *S. robustus* MacCallum, 1917; and *Stephanostomum sobrinum* (Levinsen, 1881) Looss, 1899—are insufficiently described. Since the genus is a large one and widely distributed among marine fishes, a list of species and a key to aid in their identification is presented.

For many years species in this genus were considered in the genus *Stephanochasmus*, which Looss (1900) named for them because he considered *Stephanostomum* invalidated by *Stephanostoma* Danielsen and Koren, 1880. As *Stephanochasmus* species were transferred to *Stephanostomum*, the literature frequently did not clearly indicate the authors of new combinations. Of the species in the following list, Dawes (1946) seems to have first used the combination in one case, while four seem to be new combinations. Synonyms of only the new combinations are listed here.

#### SPECIES OF STEPHANOSTOMUM

*anisotremi* Manter, 1940

*baccatum* (Nicoll, 1907) Manter, 1934

*bicoronatum* (Stossich, 1883) Manter, 1940

*caducum* (Looss, 1901) Manter, 1934

*californicum* (p. 328), new species

*casum* (Linton, 1910) McFarlane, 1936

*cesticillum* (Molin, 1858) Looss, 1899 (type species)

*cloacum* (Srivastava, 1938), new combination; synonym *Echinostephanus*

*cloacum* Srivastava, 1938

*coryphaenae* Manter, 1947

*dentatum* (Linton, 1900) Manter, 1931

*ditrematis* (Yamaguti, 1939) Manter, 1947

*elongatum* (Park, 1939) Hanson, 1950

*fistulariae* (Yamaguti, 1940) new combination; (synonym *Echinostephanus fistulariae* Yamaguti, 1940)

*hispidum* (Yamaguti, 1934) Manter, 1940

*imparispine* (Linton, 1905) Manter, 1940



- japonicum* (Yamaguti, 1934), new combination; (synonym *Stephanochasmus japonicus* Yamaguti, 1934)  
*lineatum* Manter, 1934  
*megacephalum* Manter, 1940  
*microstephanum* Manter, 1934  
*minutum* (Looss, 1901) Manter, 1940  
*multispinosum* Manter, 1940  
*pristis* (Deslongchamps, 1824) Looss, 1899  
*promicropsi* Manter, 1947  
*rhombispinosum* (Lebour, 1908) Manter, 1934  
*sentum* (Linton, 1910) Manter, 1947  
*tenue* (Linton, 1898) Linton, 1940  
*triglae* (Lebour, 1908) Dawes, 1946  
*tristephanum* McFarlane, 1935

## KEY TO SPECIES OF STEPHANOSTOMUM

1	(6) Three rows of oral spines.....	2
2	(5) Spines very numerous (140 or more).....	3
3	(4) Vitellaria extending anterior to acetabulum.....	<i>microstephanum</i>
4	(3) Vitellaria not reaching acetabulum.....	<i>tristephanum</i>
5	(2) Spines 50 to 52.....	<i>lineatum</i>
6	(1) Two rows of oral spines.....	7
7	(14) Vitellaria interrupted opposite testes.....	8
8	(9) Oral spines rhomboid.....	<i>rhombispinosum</i>
9	(8) Oral spines elongate.....	10
10	(11) Oral spines 36; vitellaria not reaching cirrus sac.....	<i>pristis</i>
11	(10) Oral spines at least 48; vitellaria reaching cirrus sac.....	12
12	(13) Sucker ratio 1:1.....	<i>caducum</i> <sup>4</sup>
13	(12) Sucker ratio 1:2.....	<i>promicropsi</i>
14	(7) Vitellaria not interrupted opposite testes.....	15
15	(28) Vitellaria extending to posterior edge of acetabulum.....	16
16	(17) Oral sucker larger than acetabulum.....	<i>fistulariae</i>
17	(16) Oral sucker smaller than acetabulum.....	18
18	(19) Oral spines very numerous (about 80).....	<i>multispinosum</i>
19	(26) Oral spines considerably fewer than 80.....	20
20	(23) Eggs 96 to 126 $\mu$ long.....	21
21	(22) Suckers subequal.....	<i>triglae</i>
22	(21) Sucker ratio about 1:1.4 to 1.6.....	<i>japonicum</i>
23	(20) Eggs 56 to 80 $\mu$ long.....	24
24	(25) Oral spines 24.....	<i>elongatum</i>
25	(24) Oral spines 36 or more.....	26
26	(27) Oral spines 36; prepharynx considerably longer than pharynx.....	<i>casum</i>
27	(26) Oral spines 48 to 50; prepharynx not considerably longer than pharynx.....	<i>dentatum</i>
28	(15) Vitellaria not reaching acetabulum.....	29
29	(40) Vitellaria reaching only to base of cirrus sac or slightly beyond.....	30
30	(31) Oral spines 56; eggs 87 to 101 $\mu$ .....	<i>baccatum</i> <sup>5</sup>

<sup>4</sup> Lebour's (1907) specimen of *S. caducum* from the whiting did not have interrupted vitellaria. It may represent another species. It is much like *S. ditrematis* except for its equal suckers.

<sup>5</sup> Nicoll's original specimen of *S. baccatum* had vitellaria extending only to base of cirrus sac. He later described a somewhat more anterior extent but not to the acetabulum. Manter's (1926) figure shows the vitellaria to the acetabulum. Thus, there is some uncertainty regarding this character in this species.

31	(30)	Oral spines not over 48; eggs not over $85\mu$ .....	32
32	(33)	Suckers subequal; oral spines interrupted ventrally.....	megacephalum
33	(32)	Acetabulum larger than oral sucker; oral spines not interrupted ventrally .....	34
34	(35)	Numerous vitelline follicles between ovary and anterior testis .....	ditrematis
35	(34)	No or very few vitelline follicles between ovary and anterior testis	36
36	(37)	Cirrus sac not reaching halfway to ovary; oral spines 36.....	sentum
37	(36)	Cirrus sac reaching halfway or more to ovary; oral spines not 36	38
38	(39)	Sucker ratio about 1:2; oral spines 38 to 40.....	anisotremi
39	(38)	Sucker ratio about 1:1.26; oral spines 33 to 34.....	imparispine
40	(29)	Vitellaria extending some distance along cirrus sac but not reaching acetabulum .....	41
41	(42)	Length not over 1.9 mm.; eggs about $47\mu$ long.....	minutum
42	(41)	Length much over 1.9 mm.; eggs at least $60\mu$ long.....	43
43	(44)	Acetabulum about twice size of oral sucker.....	bicoronatum
44	(43)	Acetabulum considerably less than twice size of oral sucker.....	45
45	(48)	Oral spines 40 to 42.....	46
46	(47)	Numerous vitellaria between ovary and anterior testis.....	hispidum
47	(46)	Few or no vitellaria between ovary and anterior testis.....	tenu <sup>6</sup>
48	(45)	Oral spines 30 to 36.....	49
49	(50)	Cirrus sac extending considerably more than halfway to ovary .....	cloacum
50	(49)	Cirrus sac extending only halfway or less to ovary.....	51
51	(52)	Cirrus sac S-shaped, wider in anterior half.....	coryphaenae
52	(51)	Cirrus sac almost straight; wider in posterior half .....	53
53	(54)	Eggs 94 to $109\mu$ long.....	californicum
54	(53)	Eggs $80\mu$ long.....	cesticillum

## STEPHANOSTOMUM CALIFORNICUM, new species

## PLATE 13, FIGURE 13

*Description* (based on the single specimen collected).—Length 4.786 mm., greatest width 0.482 mm., near posterior end. Oral sucker 0.219 mm., acetabulum 0.321 mm. in transverse diameters; sucker ratio approximately 1:1.47. Oral spines 33, although a space at the middorsal line suggests that a thirty-fourth spine had been lost; spines in anterior row 80 to  $90\mu$  long; spines in posterior row 61 to  $78\mu$  long. Forebody length 1.255 mm. or slightly less than one-fourth body length; posttesticular distance 0.606 mm. or approximately one-half length of forebody. Prepharynx 0.547 mm. long; pharynx pyriform, 0.292 mm. long by 0.255 mm. wide; esophagus very short; intestinal bifurcation a short distance preacetabular; ceca extending close to posterior end of body, probably opening into excretory vesicle.

<sup>6</sup> Linton (1940) has reported *S. tenue* from six hosts at Woods Hole, but his figures 32 and 34, with very different extent of the cirrus sac, suggest that he may have dealt with more than one species. Martin (1939) has described the life cycle of this species.

Genital pore median (gp, pl. 13, fig. 13), immediately preacetabular. Testes (t) tandem in posterior third of body, elongated, separated by a few vitelline follicles; cirrus sac slightly sinuous extending 0.511 mm. posterior to acetabulum or approximately one-third distance to ovary. Ovary (ov) elongate, about two-thirds body length from anterior end; separated from anterior testis by a few vitelline follicles. Vitelline follicles (v) extending anteriorly to a point slightly beyond midway between base of cirrus sac and acetabulum although not quite so far on one side; not reaching acetabulum; not interrupted opposite testes; dorsal, ventral, and lateral to ceca; dorsal to testes and ovary but not to the uterus. Uterus preovarian; metraterm not evident; eggs very large, ovoid, 94 to 109 $\mu$  by 43 to 58 $\mu$ .

*Host*.—*Umbrina roncadore* Jordan and Gilbert, yellowfin croaker.

*Location*.—Intestine.

*Holotype*.—U.S.N.M. Helm. Coll. No. 37149.

*Discussion*.—This species differs from most other *Stephanostomum* species in its very large eggs. It seems to be most like *S. cesticillum* (Molin, 1858) Looss, 1899 and *S. bicoronatum* (Stossich, 1883) Manter, 1940, which it resembles in number of oral spines and extent of vitellaria. *S. bicoronatum* differs in that the oral sucker is only one-half the diameter of the acetabulum, the cirrus sac extends halfway to the ovary, a metraterm is well developed, and eggs are about 80 $\mu$  by 50 to 55 $\mu$  (or 63 to 78 $\mu$  by 33 to 45 $\mu$  according to Yamaguti (1938). *S. cesticillum* has eggs 80 $\mu$  by 50 to 55 $\mu$ , an oral sucker only slightly smaller than the acetabulum, and a cirrus sac extending more than halfway to the ovary, a conspicuous metraterm, and its oral spines are at least usually interrupted ventrally by a spine lacking or by small spines.

*S. imparispine* (Linton, 1905) Manter, 1940, has 33 or 34 oral spines but differs in that the vitellaria do not extend so far anteriorly, do not extend between the gonads, and the eggs are only 70 by 40 $\mu$  in size.

Species that also have large eggs are *S. japonicum* (Yamaguti, 1934), which differs in that the vitellaria extend to the acetabulum and there are 46 oral spines; *S. triglae* (Lebour, 1908), differing from *S. californicum* in these same respects; and *S. baccatum* (Nicoll, 1907), which has 56 oral spines and tapered eggs.

#### STEPHANOSTOMUM DENTATUM (Linton, 1900) Manter, 1931

*Echinostephanus pagrosomi* Yamaguti, 1939, p. 221.

*Stephanostomum pagrosomi* (Yamaguti, 1939) Manter, 1947, p. 308.

*Host*.—*Paralichthys californicus* (Ayres),<sup>†</sup> California halibut.

*Location*.—Intestine.

<sup>†</sup> New host record.

*Discussion.*—The three specimens collected agree with most of the important specific characters of *S. dentatum*, such as: continuous distribution of vitellaria to the acetabulum, 48 to 50 oral spines, and contiguous gonads. The forebody is extended, and the prepharynx is about twice the length of the pharynx or longer than in most specimens of *dentatum*. Sucker ratios are 1:1.33; 1:1.37 and 1:1.625 or slightly above the ratio (1:1.22) described for *dentatum*. Eggs are 61 to 68 $\mu$  by 42 to 50 $\mu$ . These measurements approach or reach those given for *S. pagrosomi* (Yamaguti, 1939), which Manter (1947, p. 308) pointed out was very similar to *S. dentatum*. It is here considered a synonym.

Genus PLEORCHIS Railliet, 1896

PLEORCHIS CALIFORNIENSIS, new species

PLATE 13, FIGURE 14

*Description* (based on two mature and five immature specimens. Measurements given are for the mature specimens).—Length 4.901 to 6.435 mm.; width 1.495 to 2.058 mm.; a specimen 3.536 mm. long is immature. Oral sucker 0.365 to 0.400 mm. in transverse diameter, somewhat wider than long; acetabulum circular, 0.292 mm. in diameter; sucker ratio 1:0.73 to 0.8. Forebody 0.766 to 1.261 mm. or about one-fifth to one-sixth body length. Anterior half of body with large conspicuous spines. A pair of small, rather widely separated eye spots on the dorsal surface at, or slightly posterior to, posterior edge of oral sucker. In the holotype (largest) specimen, the eye spots show signs of being lost and the one on the left has disappeared although very fine black granules occur at its location. Prepharynx 0.043 to 0.243 mm. long, varying with contraction of the forebody; when extended it is almost as long as the pharynx; pharynx 0.215 by 0.241 mm. long by 0.219 to 0.234 mm. wide; esophagus a very short narrow tube only 0.021 to 0.029 mm. long; ceca with anteriorly directed arms 0.343 to 0.438 mm. long (ace, pl. 13, fig. 14), and with short lateral branches (ca) arising from outer (or lateral) edges beginning shortly posterior to acetabulum; ceca ending near posterior end of body. Testes in dorsoventral pairs arranged in two longitudinal rows, usually 26 or 27 pairs in each row to total 104 to 108 testes; smallest number observed was 21 and 25 pairs or 92 testes. Testes wider than long, close together in the rows. Cirrus sac thin walled, containing a large, ovoid seminal vesicle, more or less clearly divided into a narrowing anterior portion curving around the acetabulum and a saclike posterior portion (sv); extending well posterior to acetabulum to near the ovary; prostatic cells few; cirrus tubular, unspined. Ovary lobed with short, thick



lobes all close together; slightly to right of midline; not far posterior to acetabulum. Mehlis' gland anterior to ovary, between ovary and seminal vesicle; seminal receptacle lacking; uterus short, preovarian; eggs few, rather thin shelled, variable in size (owing to abnormal shapes), normal eggs  $59$  to  $67\mu$  by  $40$  to  $45\mu$ . Genital pore (gp) median, immediately preacetabular. Vitelline follicles (v) close together, extending from slightly posterior to acetabulum to posterior end of body, covering most of the ceca; confluent posterior to testes. Excretory pore terminal; excretory vesicle I-shaped extending to posterior end of ovary where it flares out laterally to receive the collecting tubes.

*Host*.—*Cynoscion nobilis* (Ayres), white sea bass.

*Location*.—Intestine.

*Types*.—Holotype and paratype, U.S.N.M. Helm. Coll. No. 37148.

*Discussion*.—The genus *Pleorchis* contains three other species: *P. polyorchis* (Stossich, 1892) Railliet, 1896; *americanus* Lühe, 1906; and *sciaenae* Yamaguti, 1938. Manter (1949) has indicated that *P. mollis* (Leidy, 1856) Stiles, 1896, almost certainly does not belong in the genus. *Pleorchis oligorchis* Johnston, 1914, was transferred to the genus *Schistorchis* by Yamaguti (1942). *P. californiensis* differs from all three species in possessing many more testes (almost twice as many as occur in any of the other species). It has a much shorter esophagus than does *P. americanus*. The vitellaria do not reach to the acetabulum as they do in the other three species. The ovary is more deeply lobed than in *P. sciaenae*.

The family Pleorchidae was named by Poche (1926) to include *Pleorchis* Railliet and *Schistorchis* Lühe, 1906. Cable and Hunninen (1942) pointed out that these two genera seemed unrelated and that *Pleorchis* should be considered in the family Acanthocolpidae. *Schistorchis*, with its unspined body and presence of a seminal receptacle, seems more closely related to *Decemtestis* Yamaguti, 1934. Since *Pleorchis* is the type genus of the Pleorchidae, its transfer to the family Acanthocolpidae forces the family Pleorchidae to become a synonym of Acanthocolpidae. *Pleorchis*, at least superficially, suggests the subfamily Campulinae (family Fasciolidae). Similarities include such characters as large size, body spines, H-shaped ceca, lack of seminal receptacle, I-shaped excretory vesicle, preovarian uterus, and extensive vitellaria. The testes are entirely different and the Campulinae are parasites of marine mammals. Probably an important difference is the presence of very definite eyespots on *Pleorchis*, the cercariae of which must therefore be oculate. Eyespots are lacking in all the known life cycles of Fasciolidae. The H-shaped ceca may have developed independently in *Pleorchis* and in Campulinae as well as in the Accacoeliidae.

## Family ZOOGONIDAE

Genus DIPLANGUS Linton, 1910

DIPLANGUS TRIRADIATUS, new species

PLATE 13, FIGURES 15, 16

*Description* (based on nine mature and eight immature specimens from *Menticirrhus undulatus* and *Roncador stearnsi*).—Length 0.686 to 0.967 mm. One specimen 0.702 mm. in length did not contain eggs although gonads were well developed; another 0.686 mm. in length did contain eggs. Body smooth, cylindrical, greatest width or thickness near acetabular level, 0.195 to 0.273 mm. Forebody tapering but rounded, hindbody tapering and more pointed. Acetabulum protrusible and in all specimens greatly extended so that the acetabular stalk is almost as long as or even longer than the hindbody; in one specimen the distance from the acetabulum edge to dorsal wall of body was practically the same as the total body length. Base of acetabular stalk from one-third to one-half body length from anterior end of body. The lateral position of most specimens prevented transverse measurements of the suckers. Oral sucker length 0.093 to 0.099 mm., thickness 0.081 to 0.093 mm., width (two specimens) 0.083 to 0.092 mm. Acetabulum length 0.135 to 0.172 mm., thickness (one specimen) 0.135 mm., width 0.144 to 0.179 mm. Ratio of lengths of oral sucker and acetabulum 1:0.91 to 2. Genital pore (gp, pl. 13, figs. 15, 16) median or submedian, opposite base of pharynx or slightly posterior to pharynx. Short prepharynx present; pharynx often but not always with a median constriction, 0.054 to 0.063 mm. long, 0.029 to 0.050 mm. wide or thick. Esophagus (e) longer than pharynx, wide and thin walled. Ceca (ic) sinuous and extending to level of middle of anterior testis, some distance from posterior end of body, or rarely to posterior edge of posterior testis. Excretory pore terminal; excretory vesicle I-shaped, extending past the posterior testis, ending dorsal to anterior testis. Testes globular, diagonal, about midway between acetabular stalk and posterior end of body. Genital atrium (ga) a short thin-walled tube. Cirrus (cir) thick-walled, bulblike, becoming thin walled just before joining the atrium; cirrus sac and prostatic vesicle apparently lacking; seminal vesicle tubular, bipartite with a saclike, thin-walled anterior portion (sv<sup>1</sup>) and a swollen S- or V-shaped tube (sv<sup>2</sup>) with cellular walls (fig. 16); vesicle ending near base of acetabular stalk. Ovary globular, slightly anterior to but overlapping the anterior testis, to left of midline. Seminal receptacle (sr) round, well developed, preovarian. Vitellaria (v) in two lateral clumps

of follicles at ovarian level; follicles fairly large, 8 or 9 on each side, often pressed close together. Uterus extending posterior to testes; eggs, more or less collapsed in utero, 27 to  $34\mu$  by 13 to  $18\mu$ , almost always 32 to  $34\mu$  by 13 to  $16\mu$ .

About 10 specimens from a related host, *Umbrina roncadore*, differed only in being somewhat larger (to 1.802 mm. in length), suckers somewhat nearer equal in size, and almost always in having a longer space between posterior extent of the uterus and posterior end of body.

*Hosts*.—*Menticirrhus undulatus* (Girard), California corbina; *Roncadore stearnsi* (Steindachner), spotfin croaker; *Umbrina roncadore* Jordan and Gilbert, yellowfin croaker.

*Location*.—Intestine.

*Types*.—Holotype and paratype, U.S.N.M. Helm. Coll. No. 37147.

*Discussion*.—*D. triradiatus* differs from *D. parvus* Manter, 1947, in its pointed posterior end, longer hindbody, much smaller acetabulum and in lack of a prostatic vesicle. It differs from *D. miolecithus* Manter, 1947, in development of the vitellaria, shorter ceca, diagonal testes, lack of prostatic vesicle, and smaller eggs. It is probably most similar to *D. paxillus* Linton, 1910. Some apparent differences such as the more posterior genital pore and the sinuous ceca might be due to the extreme extension of the acetabulum. However, *D. triradiatus* has diagonal rather than tandem testes, the excretory vesicle extends past the posterior testis, a distinct prostatic vesicle is lacking, and the eggs are almost always distinctly smaller (usually 32 to  $34\mu$  by 13 to  $16\mu$  as compared with 34 to  $45\mu$  by 14 to  $18\mu$ ). Eggs of *D. paxillus* were measured in nine specimens from several host species at Tortugas, Fla., and only in one (from *Balistes vetula*) were eggs found less than  $34\mu$  long.

The name *triradiatus* is suggested by the triradiate appearance given the body by the long acetabular stalk.

## Family HAPLOSPLANCHNIDAE

Genus HAPLOSPLANCHNUS Looss, 1902

HAPLOSPLANCHNUS GIRELLAE, new species

PLATE 13, FIGURES 17, 18

*Description*.—Small, elongate distomes of about equal width and thickness; widest and thickest at acetabular level; rounded anteriorly but narrowing almost to a point posteriorly. The following measurements are based on seven specimens showing a dorsal or ventral view and three specimens showing, as did most of the specimens, a side view (pl. 13, fig. 17). Length 1.073 to 1.569 mm.; width 0.219 to 0.290 mm.; thickness 0.226 to 0.277 mm. Oral

sucker (os) wider than long; 0.153 to 0.204 mm. in transverse diameter; 0.153 to 0.197 mm. in depth (dorsoventral). Dorsal wall of oral sucker much thicker than ventral wall; a small papillalike projection often visible on midventral line. Acetabulum, including aperture, slightly wider than long; 0.157 to 0.219 mm. in transverse diameter or subequal to oral sucker; sucker ratio 1:0.85 to 1.04. Depth of acetabulum, as seen from side view, 0.124 to 0.146 mm. or somewhat less than depth of oral sucker. Forebody 0.299 to 0.431 mm.

Prepharynx very short; pharynx (ph) globular, 0.043 to 0.076 mm. long by 0.048 to 0.068 mm. wide by 0.051 to 0.059 mm. thick. Esophagus (e) not clearly demarked from cecum; cecum (ic) extending to a point one-fourth to two-thirds distance from acetabulum to posterior end of body, usually ending dorsal to testis.

Genital pore median, slightly nearer to oral sucker than to acetabulum, opposite posterior edge of pharynx or slightly posterior to that level. Single testis (t), elongated oval, 0.182 to 0.277 mm. long by 0.116 to 0.138 mm. wide, smooth; located usually somewhat anterior to middle of hindbody; posttesticular space very long, 0.292 to 0.474 mm., in only one specimen was it shorter than the forebody. Cirrus a thick-walled tube extending diagonally backward from genital pore, sometimes appearing spherical from surface view; prostatic vesicle (pv) ovoid to elongate, not apparent in many specimens; seminal vesicle (sv) a slightly sinuous tube ending dorsal to acetabulum; entering ventral side of prostatic vesicle slightly posterior to its middle.

Ovary (ov) spherical or ovoid, immediately posterior to acetabulum or partly dorsal to acetabulum, pretesticular, median or submedian, usually slightly dextral. Seminal receptacle spherical or ovoid, largely dorsal and slightly posterior to ovary. Vitelline glands (v) not in definite follicles but in irregular longitudinal masses, lateral, usually from level of pharynx to well posterior to testis; always interrupted opposite testis. Anterior extent of vitellaria seems to be the anterior border of acetabulum although large cells in the forebody probably are vitelline cells; the posterior extent varies from one-half to four-fifths distance between testis and posterior end of body. Uterus preovarian, short, dorsal to left half of acetabulum. Eggs (fig. 18) large, few (1 to 7), measuring (uncollapsed) 73 to 80 $\mu$  by 48 to 53 $\mu$ . Excretory vesicle forking dorsal to testis.

*Host*.—*Girella nigricans* (Ayres), common opaleye.

*Location*.—Intestine.

*Number*.—Very numerous.

*Types*.—Holotype and paratype, U.S.N.M. Helm. Coll. No. 37144.

*Discussion*.—Of the eight known species of *Haploplanchnus*, *H.*



*girellae* is probably most similar to *H. kyphosi* Manter, 1947, and *H. obtusus* (Linton, 1910) from Tortugas, Fla. It differs from *H. obtusus* in its long posttesticular space, in the spherical shape of the seminal receptacle, in lacking distinct vitelline follicles, in the interruption of the vitellaria opposite the testis, and in shape of the eggs. It differs from *H. kyphosi* in its unlobed ovary, relatively larger acetabulum, elongated testis, interrupted vitellaria, and smaller body size.

### Family MONORCHIDAE

Genus PROCTOTREMA Odhner, 1911

PROCTOTREMA LONGICAECUM Manter, 1940

*Host.*—*Anisotremus davidsonii* (Steindachner),<sup>8</sup> California sargo.

*Location.*—Intestine.

*Number.*—Two.

*Discussion.*—This species is known hitherto from *Anisotremus interruptus* (Gill) from the Galápagos Islands.

### Family HEMIURIDAE

Genus APONURUS Looss, 1907

APONURUS TRACHINOTI Manter, 1940

*Host.*—*Porichthys* sp.<sup>8</sup>

*Location.*—Stomach.

*Discussion.*—A single specimen agrees with the description of *A. trachinoti* except in one respect: the eggs measure 30 to 32 $\mu$  by 13 $\mu$  rather than 25 by 10 $\mu$ . Since our specimen is somewhat larger (1.77 mm. long) and no other differences could be seen, it is felt a new species should not be named. Characteristic features are the shape of the egg (pointed at one end), ceca not reaching the posterior end, and the relatively small acetabulum (slightly less than twice the size of the oral sucker).

Genus BRACHADENA Linton, 1910

BRACHADENA PYRIFORMIS Linton, 1910

*Hosts.*—*Anisotremus davidsonii* (Steindachner),<sup>8</sup> California sargo; *Porichthys* sp.<sup>9</sup>

*Location.*—Stomach.

<sup>8</sup> New host record.

<sup>9</sup> In the field this host was identified as *Porichthys notatus* Girard. Specimens were not saved for later verification, but it seems probable that the hosts were the locally more common *Porichthys myriaster* Hubbs and Schultz, which had been recognized only a short time when this study was in progress.

*Discussion.*—A single specimen was collected from each of the above hosts. Sucker ratio in this species is rather variable. The specimen from *Porichthys* has approximately a 1:2 ratio rather than the more usual 1:2.5 to 3. However, a 1:2 ratio occurs in Atlantic specimens from *Ogcocephalus radiatus*, *Micropogon undulatus*, and *Calamus bajonado*. This trematode is very common at Tortugas, Fla., where it has numerous hosts, and it is known also from North Carolina and Massachusetts. This record is the first from the Pacific.

Genus ELYTROPHALLUS Manter, 1940

ELYTROPHALLUS MEXICANUS Manter, 1940

*Host.*—*Paralabrax clathratus* (Girard),<sup>10</sup> kelp bass.

*Location.*—Intestine.

*Number.*—Two.

*Discussion.*—This species was found to be common in a variety of fishes of Socorro and Clarion Islands (Mexico) and less common in the Galápagos Islands (Manter, 1940). The trematode is normally a stomach parasite.

In the following list of fishes the species are arranged by families in the sequence followed in the Jordan, Evermann, and Clark checklist (1930).

## HOST LIST

### CYPRINODONTIDAE: Killifishes

*Fundulus parvipinnis parvipinnis* Girard, southern California killifish:  
*Phyllodistomum* sp.

### BOTHIDAE: Sinistral Flatfishes

*Paralichthys californicus* (Ayres), California halibut:  
*Bucephalopsis labiatus*, new species.  
*Stephanostomum denatum* (Linton, 1900).  
Immature hemiurid.  
Immature *Distomum fenestratum*.

### SERRANIDAE: Sea Basses

*Mycteroperca pardalis* Gilbert:  
*Lepidapedon* sp.  
*Paralabrax clathratus* (Girard), kelp bass:  
*Elytrophallus mexicanus* Manter, 1940.  
*Plagioporus isaitschikowi* (Layman, 1930).

### HAEMULIDAE: Grunts

*Anisotremus davidsonii* (Steindachner), California sargo:  
*Brachadena pyriformis* Linton, 1910  
*Proctotrema longicaecum* Manter, 1940

<sup>10</sup> New host record.

## GIRELLIDAE: Nibblers

- Girella nigricans* (Ayres), common opaleye:  
*Haploplanchnus girellae*, new species.  
*Opechona orientalis* (Layman, 1930).  
*Opecoelus adsphaericus*, new species.

## SCIAENIDAE: Croakers

- Menticirrhus undulatus* (Girard), California corbina:  
*Diplangus triradiatus*, new species.  
*Roncador stearnsi* (Steindachner), spotfin croaker:  
*Diplangus triradiatus*, new species.  
*Umbrina roncadore* Jordan and Gilbert, yellowfin croaker:  
*Diplangus triradiatus*, new species.  
*Genitocotyle acirrata* Park, 1937.  
*Pseudopecoelus umbrinae*, new species.  
*Stephanostomum californicum*, new species.  
*Cynoscion nobilis* (Ayres), white sea bass:  
*Pleorchis californiensis*, new species.

## COTTIDAE: Sculpins

- Clinocottus analis australis* Hubbs, tide-pool woolly sculpin:  
*Helicometrina elongata* Noble and Park, 1937.  
*Opecoelus adsphaericus*, new species.

## EMBIOTOCIDAE: Surfperches and Sea perches

- Damalichthys vacca* Girard, pileperch:  
*Genitocotyle acirrata* Park, 1937.

## GOBIIDAE: Gobies

- Gillichthys mirabilis* Cooper, mudsucker:  
 Immature hemiurid.

## CLINIDAE

- Gibbonsia elegans* (Cooper), ocellated sawfish:  
*Bucephalus* sp., immature, encysted.  
*Helicometrina elongata* Noble and Park, 1937.  
*Gibbonsia metzi* Hubbs, weed sawfish:  
*Helicometrina elongata* Noble and Park, 1937.  
*Pseudopecoelus gibbonsiae*, new species.

## BATRACHOIDIDAE

- Porichthys* sp.:  
*Aponurus trachinoti* Manter, 1940.  
*Brachadena pyriformis* Linton, 1910.

An examination of the foregoing list reveals a striking degree of fidelity between the digenetic trematodes and their definitive marine fish hosts in southern California. Only 3 of the 17 species of digenetic trematodes identified in this study have been found to transgress family bounds in their definitive hosts. These are *Helicometrina elongata*, *Genitocotyle acirrata*, and *Opecoelus adsphaericus*.

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## EXPLANATION OF PLATES

All drawings were made from stained permanent mounts in clarite, by aid of a camera lucida. Katharine Hill Paul, scientific artist in the department of zoology of the University of Illinois, prepared the drawings and arranged the plates.

### SYMBOLS USED

a, anus	lt, lateral excretory trunk
ac, acetabulum	mt, median excretory trunk
ace, anterior cecum	o, egg
ap, acetabular papilla	ol, oral lip
as, anterior sucker	os, oral sucker
ca, cecal arm	ov, ovary
cir, cirrus	ph, pharynx
cs, cirrus sac	pv, prostatic vesicle
e, esophagus	sr, seminal receptacle
es, eye spots	sv, seminal vesicle
ex, excretory vesicle	t, testis
ga, genital atrium	ut, uterus
gp, genital pore	v, vitellaria
ic, intestinal cecum	yr, yolk reservoir

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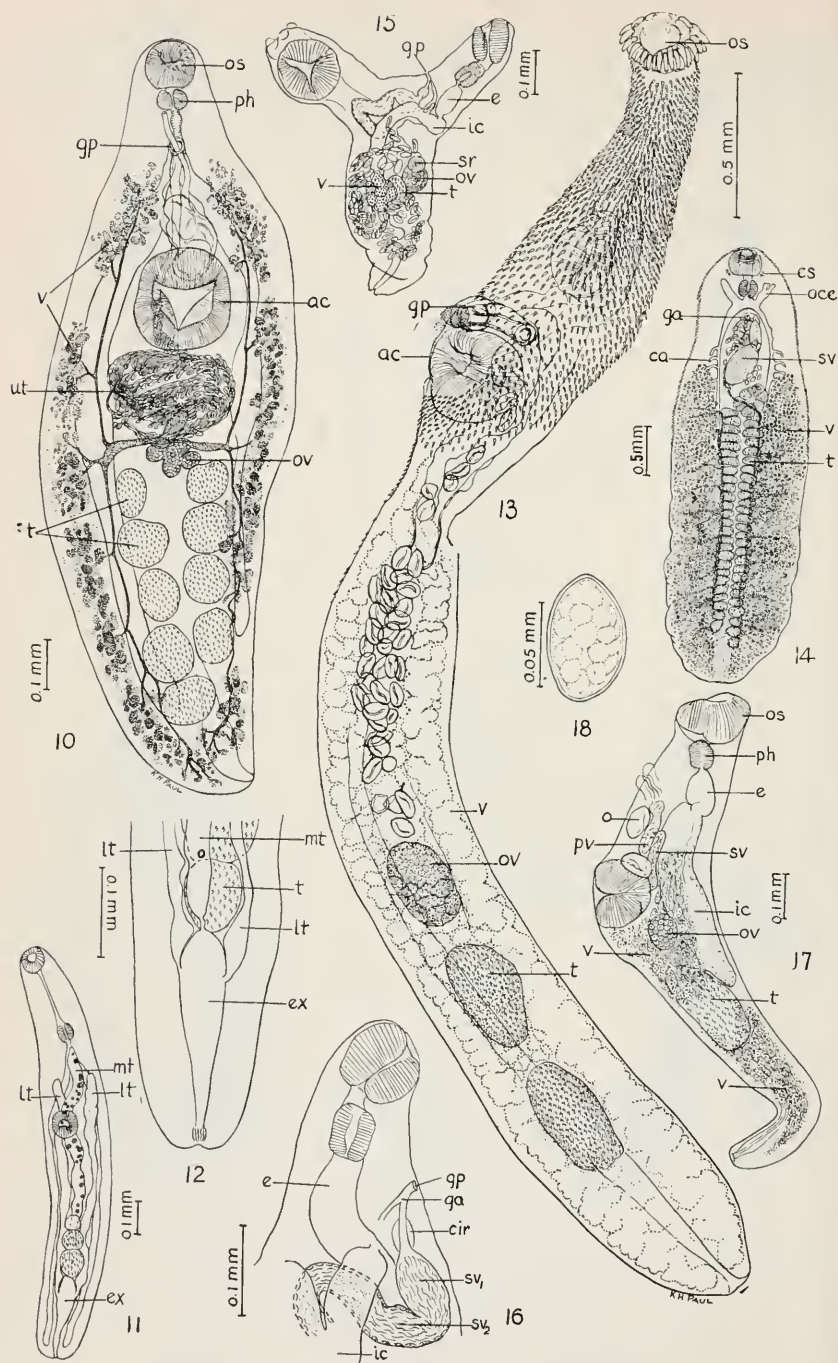
### PLATE 12

- 1, 2. *Bucephalopsis labiatus*, new species: 1, Holotype as viewed from ventral surface; 2, lateral view of pharynx and oral lip as seen in a paratype individual.
- 3-5. *Opecoelus adspheericus*, new species: 3, Holotype as viewed from right side; 4, acetabulum of a paratype as viewed from lateral surface to show papillae, one pair of the lateral papillae not shown; 5, region of genital atrium showing relations of ducts to other structures.
- 6, 7. *Pseudopecoelus gibbonsiae*, new species: 6, Holotype in side view; 7, detail showing structures associated with the genital atrium.
- 8, 9. *Pseudopecoelus umbrinae*, new species: 8, Holotype as viewed from ventral surface; 9, relations of genital ducts to the genital pore in a paratype individual.

### PLATE 13

10. *Helicometrina elongata* Noble and Park, 1937, viewed from the ventral surface. Specimen from intestine of *Clinocottus analis australis*.
- 11, 12. *Opechona orientalis* (Layman, 1930) Ward and Fillingham, 1934: 11, Entire worm chiefly from ventral view; 12, detail of posterior extremity showing relations of the excretory trunks and vesicle.
13. *Stephanostomum californicum*, new species: Morphology of holotype.
14. *Pleorchis californiensis*, new species: Holotype as viewed from dorsal surface. Only the dorsal series of testes is shown.
- 15, 16. *Diplangus triradiatus*, new species: 15, Holotype in side view; 16, Anterior extremity of a paratype, showing details of structure.
- 17, 18. *Haplospilachnus girellae*, new species: 17, Holotype in lateral view; 18, a single uterine egg.





SPECIES OF *HELICOMETRINA*, *OPECHONA*, *STEPHANOSTOMUM*, *PLEORCHIS*, *DIPLANGUS*, AND *HAPLOSPIANCHUS*.









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## PARASITIC CRUSTACEA FROM BIMINI, BAHAMAS

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By A. S. PEARSE

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THIS paper deals with the parasitic copepods, isopods, and barnacles collected from fishes and crustaceans during a month's work (October 13 to November 15, 1948) at the Lerner Marine Laboratory of the American Museum of Natural History at Bimini, Bahama Islands. In all, 368 fishes of 73 species were examined. Of these, 171 individuals (46 percent) of 23 species (31 percent) yielded 290 parasitic copepods, and 140 individuals of 50 species carried none. Of the crustaceans that might be expected to harbor copepods, 10 species were examined; 504 individuals of 4 species harbored 67 copepods, and 129 individuals of 6 species carried none.

Recorded or described herein are 34 species, 17 of which appear to be new. My thanks are due to Dr. C. M. Breder, director of the Lerner Laboratory, and to the resident staff, for the opportunity of making this study, for the facilities furnished, and for help in collecting. I am grateful also to the staff of the United States National Museum, who permitted me to examine Pilsbry's (1907) types of *Octolasmis geryonophila* and *O. americanum*. Paul L. Illg examined the copepod specimens with me and helped me look up rare literature.

## Class CRUSTACEA

## Order COPEPODA

## Suborder HARPACTICOIDA

## Family HARPACTICIDAE

## Genus ZAUS Goodsir

## ZAUS GOODSIRI Brady

*Zaus goodsiri* BRADY, A monograph of the free and semi-parasitic Copepoda of the British Islands, vol. 2, p. 156, pl. 66, figs. 10-13, 1880.

Two specimens, one a male and the other a female, were taken from a dish in which a squirrelfish, *Holocentrus ascensionis* (Osbeck), was kept for examination. They probably came from the fish.

## Family CANTHOCAMPTIDAE

## Genus CANCRINCOLA Wilson

## CANCERINCOLA JAMAICENSIS Wilson

*Cancerinola jamaicensis* WILSON, Proc. U. S. Nat. Mus., vol. 44, p. 264, pl. 50, fig. 281; pl. 51, figs. 282, 283; pl. 52, 1913.

Three females were taken from the gills of a crab, *Gecarcinus* sp.; 62 from the gills of 13 land crabs, *Cardisoma guanhumi* Latreille; and 2 from 489 mud crabs, *Panopeus herbstii* H. Milne-Edwards.

## Suborder CALIGOIDA

## Family CALIGIDAE

## Genus ANURETES Heller

## ANURETES BREVIS, new species

## FIGURE 67

*Male*.—Carapace a fifth wider than long, posterior angles rounded, lateral lobes reaching to the third thoracic segment and somewhat less than half total length; the lateral and posterior margins finely striate. Fourth thoracic segment one-sixth as long as wide. Genital segment a little more than half as long as wide, with two lateral elliptical areas; each bears at the posterior medial border a narrow lamina armed with four setae. No abdomen. Caudal rami one-third wider than long, triangular and truncate laterally, with three large and four small terminal plumose setae.



First antennae 2-segmented; first segment almost as long as second, armed with 19 setae on the anterior and 3 on the lateral margin; terminal segment bears six apical setae. Second antenna large and stout, the terminal claw armed with a spine and a lateral seta near base; first two segments about as long as claw. Mouth tube conical, wider at base, truncate at tip. Mandible curved at tip and bears about 15 small teeth. First maxilla spinose, bears one small lateral spine and has two setae at base (fig. 67, *d*). Second maxilla slender, bearing a long and a short terminal seta. The furculalike support between the first legs (fig. 67, *e*) is nearly three times as wide as long, the branches short and conical.

The first leg uniramous, with a posterior seta on the basal segment; second segment a third longer than first, setose posteriorly; third segment half as long as second, bearing three hooks and four plumose setae. Second leg biramous; rami 3-segmented; endopod and exopod with rounded laminae on basal segments, that on the

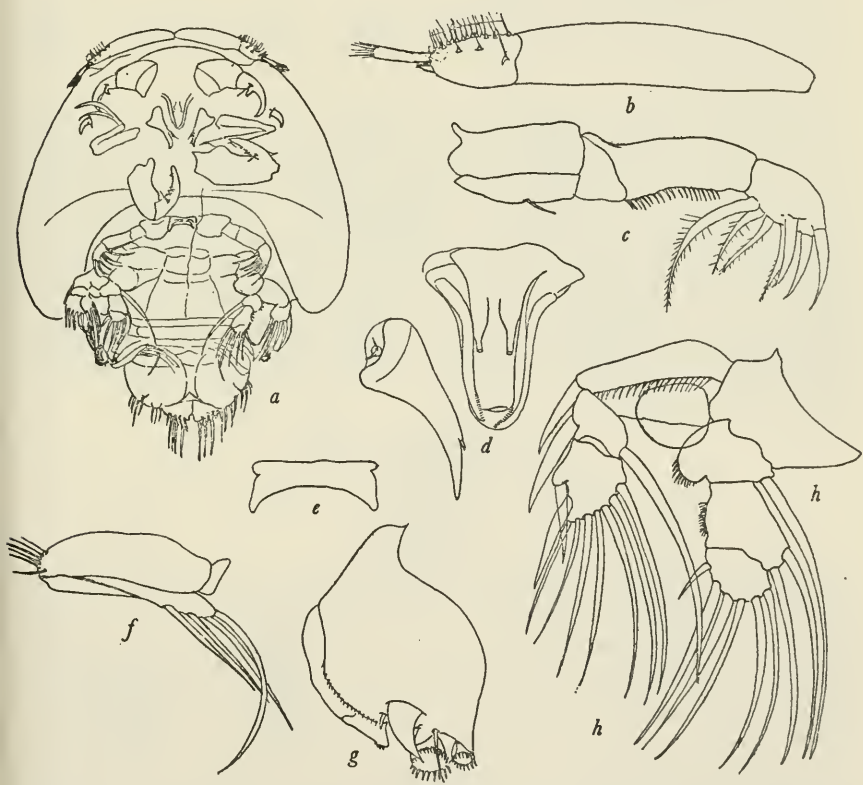


FIGURE 67.—*Anuretes brevis*, new species: *a*, Ventral view of male; *b*, frontal plate and first antenna; *c*, first leg; *d*, mouth tube and first maxilla; *e*, furculalike support between bases of first legs; *f*, fourth leg; *g*, third leg; *h*, second leg.

exterior of the endopod setose, that on the median edge of the exopod smooth; second segment of exopod with two spines and a plumose seta; terminal segment with two spines and seven plumose setae; first segment of endopod with a median plumose seta; second segment setose laterally and with two plumose setae medially; third segment with six plumose setae. Third leg biramous; with a laminate segment that bears a strong hook; exopod 2-segmented; the terminal segment ending in a spinose disc; the endopod 1-segmented and also ending in a spinose disc. Fourth leg 3-segmented; first segment short; second segment almost 20 times as long; third segment one-fourth longer than second, tipped with four long setae. Fifth legs on genital segment are laminate plates with four plumose setae.

Measurements: Body 1.55 by 1.52 mm.; genital segment 0.2 by 0.5 mm.

*Female*.—Unknown.

*Type*.—U.S.N.M. No. 88576.

*Host*.—The sheepshead, *Archosargus probatocephalus* (Walbaum); on gills.

*Remarks*.—The name indicates that the species is short. Wilson (1905) described no males. This may be the male of *Aneuretes heckelii* Krøyer (1863) or *A. parvulus* Wilson (1913), but there is no furcula, and the mouth parts and legs are so different that it seems desirable to make a new species for it; e.g., the second antenna has a seta and a spine on the inside of the terminal hook, the first maxilla has a lateral spine; the legs are different in proportions and armature, and the caudal rami are wider and more triangular than in Krøyer's species; the third legs terminate quite differently from Wilson's species.

#### Genus CALIGUS Müller

##### CALIGUS ASPERIMANUS, new species

#### FIGURE 68

*Female*.—Carapace somewhat shorter than remainder of body, slightly wider than long, the sides spreading a little posteriorly; posterior sinuses rather deep and wide; median lobe rounded. Free thoracic segments short and narrow. Genital segment barrel-shaped; about as long as abdomen. First segment of abdomen two-thirds as long as second; anal sinus well marked. Caudal rami less than half as long as second segment of abdomen; terminated by three plumose setae and three short spines, ciliated near tips medially.

Lunule large and prominent. First antennae setose on anterior margins lateral to lunules and near tips posteriorly; terminal segment slender with one claw and several setae. Second antennae small, terminal hook half as long as preceding segment. First maxilla a simple spine with two setae at base. Mouth tube broad, elliptical. Second maxilla slender, terminated by two strong curved setae. Maxilliped is most characteristic and the specific name

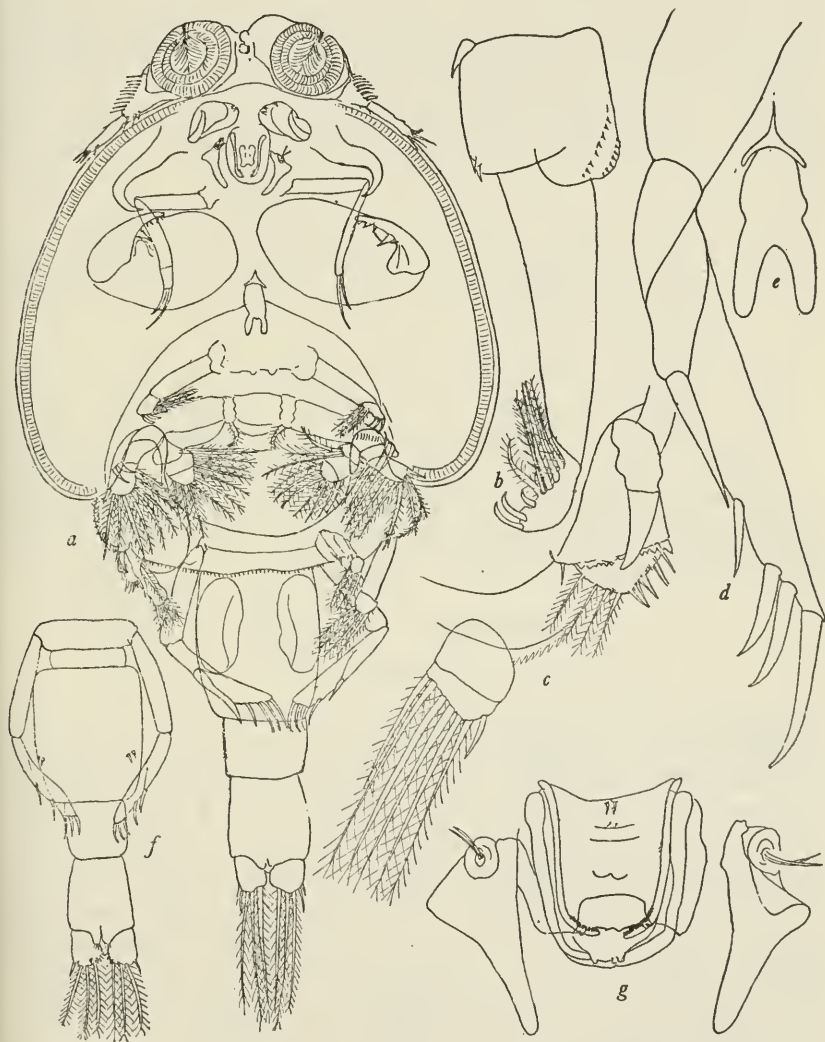


FIGURE 68.—*Caligus asperimanus*, new species: *a*, Ventral view of male. Female: *b*, first leg; *c*, third leg; *d*, fourth leg; *e*, furcula; *f*, posterior end; *g*, mouth tube and first maxillae.

("rough hand") refers to it; the terminal hook is armed midway with a strong, sharp spine, which rests against a nodule on the preceding segment, which is also armed with two short sharp spines near the tip of the hook. Furcula slender with the arms diverging very little, invested anteriorly with tripartite sharp-pointed cap.

First leg uniramous, with a broad basal joint, which bears two rows of spinules anteriorly, and a pair of short, sharp spines on the posterior-lateral angle; second segment slender, tapering, spinulose distally; terminal segment bears three hooks and four plumose setae. Second leg biramous, basal segment twice as long as wide; exopod 3-segmented, proximal segment with two spines and two plumose setae; endopod 3-segmented, with one, three, and six plumose setae. Third leg lamellate, biramous; base with a strong hook; exopod 2-segmented; proximal segment with a crinkled border and two and four curved plumose setae; endopod biramous, distal segment with a spine and six plumose setae. Fourth leg 4-segmented, with five spines. Fifth leg represented by three small spines on the genital segment.

Measurements: Body length 3.3 mm.; width of carapace 1.9 mm.

*Male*.—Similar to female, but the endopod of third leg is longer.

*Types*.—Female, U.S.N.M. No. 88563; male, U.S.N.M. No. 88562.

*Remarks*.—This species differs from *Caligus bonito* Wilson (1905), which appears to be closest to it, in the armature of the maxilliped, particularly the rough palm, the character of the furcula, and the shape of the genital segment.

CALIGUS SPINOSURCULUS, new species

FIGURE 69, a-c

*Female*.—Carapace orbicular, slightly wider than long (1.78 by 1.6 mm.); with a spinous suckerlike organ (fig. 69, c) on each side at the posterior end, and for this character the species is named; carapace less than half the total length (1.6–3.4 mm.). Genital segment oval and slightly bilobed posteriorly. Abdomen 1-segmented, rectangular, slightly curved on sides; about one-fourth as long as the genital segment (0.32–1.12 mm.); about two-thirds as wide as long (0.22–0.32 mm). Anal sinus not deep, a small papilla on either side of it, and lateral to these five or six setae. The caudal rami are short, less than one-fourth as long as abdomen; armed with four plumose setae.

Lunules shallow and small; first antennae not prominent; terminal segment slender. Second antenna small and slender; middle segment spinulose. First maxilla with a small medial spine near its middle, two setae at base. Second maxilla slender, terminated



by two curved setae. Maxilliped stout, with a short spine near base of second segment. Mouth tube rectangular, with rounded corners. Furcula small and short, the arms curved inward slightly; blunt process at each anterior angle.

First and second legs normal for caligids. Third leg with flat base that is crossed by a longitudinal row of spinules and bears a circular disc near its median border that has 9 or 10 short spines on its border and one or two in its interior; the endopod bears a hook that is smaller than the one on the basipod. The fourth leg has five very short spines near the tip and the three terminal segments are short. The fifth leg is represented by three spines at the posterior-lateral margin of the genital segment.



FIGURE 69.—*a-c*, *Caligus spinosurculus*, new species: Female: *a*, Ventral view; *b*, furcula; *c*, spiny sucker at posterolateral angle of carapace; *d*, *Caligus germoi*, new species: Ventral view of male; *e-g*, *Lernanthropus amplitergum*, female: *e*, First leg; *f*, second leg; *g*, ventral view of cephalothorax.

*Male*.—Unknown.

*Type*.—U.S.N.M. No. 88566.

*Hosts*.—A single female was taken from a gill of a yellow jack, *Caranx bartholomaei* (Cuvier and Valenciennes). Another female was collected from a gill of a common jack, *Caranx hippos* (Linnaeus). A mutilated specimen that appears to belong to this species came from a gill of a rock hind, *Epinephelus adscensionis* (Osbeck).

*Remarks*.—This species differs from *Caligus bonito* Wilson (1905) and *C. isonyx* Steenstrup and Lutken (1861) in the shape and length of the genital segment, in the short spines at the tip of the fourth leg, and in possessing a peculiar spinulose suckerlike organ at the posterior angles of the carapace and a sucker with a ring of spines on the third leg.

CALIGUS GERMOI, new species

FIGURE 69, d

*Female*.—Carapace somewhat wider than long (1.7-1.5 mm.), more than half the entire length; rather truncate than rounded at the posterior ends; lateral margins finely striate. Genital segment one-fourth wider than long, barrel shaped. Abdomen 2-segmented, one-fifth wider than long. Caudal rami slightly wider than long, armed with three long plumose and one short terminal setae and one lateral plumose seta.

On the basal segment of the first antenna are several small setae lateral to the lunule; the second segment longer than the first, which is terminated by six hooks and four setae. Second antenna stout, with two strong spines near base of hook. First maxilla with a spine on the middle of the median margin. Second maxilla, slender, with two curved terminal setae. Maxilliped with two setae near the base of the second segment; terminal claw curved, with two stout setae. Furcula with base about as long as the divergent branches, with a small spine at each of the anterior angles and a stout median anterior spine. Between the bases of the third leg a furculalike support bears a large and a small spine at each anterior lateral angle and two posterior arms that curve laterally and have acute tips.

First swimming leg uniramous; terminal segment bears three spines and six setae. Second leg biramous; exopod with three segments and its terminal segment lamellate, bearing two spines and five setae. The third leg is flattened and its basal segment is fringed with minute setae and bears a strong posterior hook; on its median margin is a sucker with five stout spines about its margin; a 1-segmented, setose exopod and a 2-segmented endopod

are present toward the median line from the hook. The fourth leg bears five terminal spines. Fifth leg represented by two short spines at the posterior end of the genital segment.

Measurements: Body length 1.7 by 2.6 mm.; genital segment 0.5 by 0.4 mm.

*Male*.—Unknown.

*Type*.—U.S.N.M. No. 88569.

*Host*.—A single female was taken from a gill of a finned albacore, *Germo alalunga* (Gmelin).

*Remarks*.—This species differs from all the others in the genus in having feebly developed lunules, in the size and the distribution of the spines on the second antennae and maxillae, the character of the furcula, the presence of a characteristic furculalike support between the bases of the third legs, and a sucker on each side of this armed with five stout spines.

#### Genus LERNANTHROPUS Blainville

##### LERNANTHROPUS AMPLITERGUM, new species

FIGURES 69, *c-g*; 70, *a*; 71

*Female*.—Body robust; dorsal plate slightly wider than regions anterior to it. Cephalothorax covered by a plate that is indented posteriorly and has a wide median projection anteriorly. In more mature individuals the posterior indentation is deeper and the sides are straighter (fig. 69, *g*), because they are turned ventrally. Second thoracic segment is almost as wide as the cephalothorax, with curved lateral margins. Third segment longer than second, wider posteriorly. Fourth segment about half as wide as third where the fourth legs are attached but bearing rounded conical lateral projections anteriorly. Genital segment less than one-third as wide as third segment. Caudal rami reach near the posterior end of the dorsal plate; slender, cylindrical. Fourth legs extend one-third their length beyond dorsal plate, which is wide and often indented in the midline posteriorly. Egg strings extend half or more of their length beyond dorsal plate; contain 42–42, 33–39, 64–71 eggs.

First antennae concealed beneath front and not visible in any specimen. Second antenna with a sharply curved terminal hook, which has a stout short spine near its base. Mouth tube conical with a wide base. First maxilla with 2 short terminal setae. Second maxilla with a terminal hook that is spinulose on the inside of its curve and is preceded by a stout spine. Maxillipeds stout, with terminal hook slightly curved.

First leg with spinulose basipod; exopod tipped with five strong spines; endopod with a long terminal seta; medial to this is a strong seta. Second leg with a spinulose basipod; exopod ends in a spinulose disc; endopod spinulose, with a single seta. Third leg uniramous, flat, lamellate. Fourth leg biramous; rami slender, tapering, rounded at tips, more than four times as long as base, extending one-third their length beyond dorsal plate. Fifth legs uniramous, cylindrical, one-tenth as long as fourth leg, extending diagonally back on each side of genital segment.

Measurements: Length 2.5–3.3 mm.

*Male*.—Like female but without a dorsal plate, smaller, and with the third legs with two slender rami instead of being flat plates. First antennae 5-segmented. Caudal rami with three spines on lateral margins.

Measurements: Length 1.8 mm.; width of carapace 0.52 mm.

*Type*.—U.S.N.M. No. 88548.

*Hosts*.—Three females were taken from the gills of porkfish,

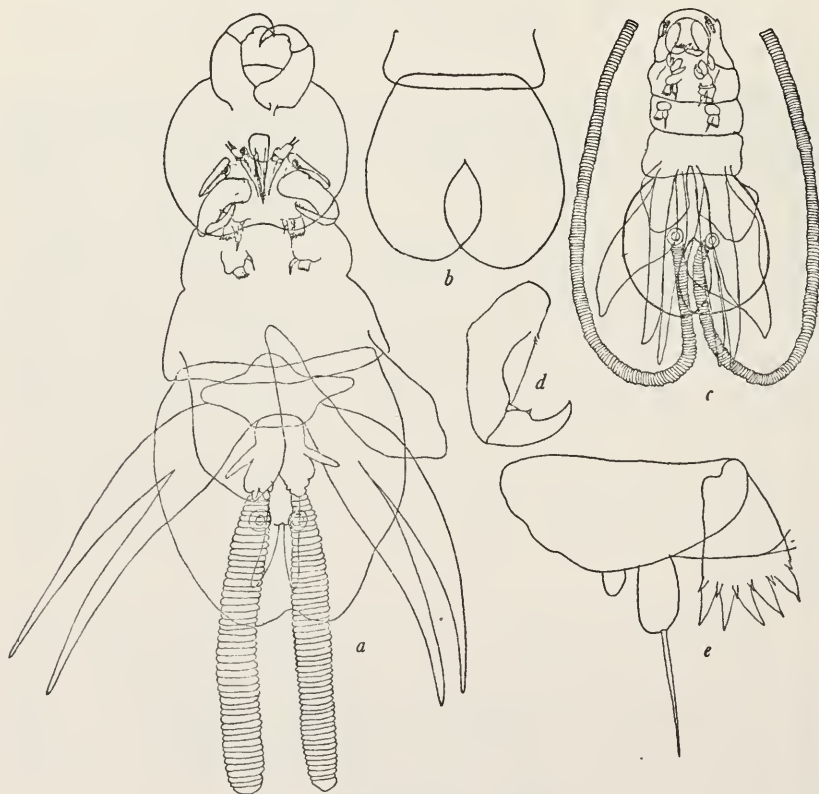


FIGURE 70.—*Lernanthropus amplitergum*, new species: *a*, Ventral view, female; *b–e*, *Lernanthropus bifidus*, female: *b*, Dorsal plate; *c*, ventral view of entire female; *d*, second antenna; *e*, first leg.



*Anisotremus virginicus* (Linnaeus), eight from the gills of margatefish, *Haemulon albidum* Cuvier and Valenciennes, three from the blue-striped grunt, *Haemulon sciurus* (Shaw), and nine from the barred grunt, *Conodon nobilis* (Linnaeus). One male was collected from a gill of a margatefish.

*Remarks.*—This species is like Wilson's (1913) *L. fondeus* and *L. spiculatus*. It differs from the former in the size of the dorsal plate and from the latter in the lack of frontal lobes and the shape and the armature of the mouth parts and legs. It differs from Steenstrup and Lutken's (1861) *L. konigii* in the shape of the cephalothorax and the dorsal plate, in the shape of the abdomen, and the smaller size of the fifth legs. It is unlike Heller's (1868) *L. lativentris* in the shape and the size of the dorsal plate and the cephalothorax; and from his *L. nobilis* in the same manner. The name refers to the wide dorsal plate.

LERNANTHROPUS BIFIDUS, new species

FIGURES 70, b-e; 72, a-d

*Female.*—Color cinnamon-brown. General form rather stocky. Cephalothorax longer than wide, with two lateral anterior lobes, the anterior one-half narrower than the posterior. Next two segments separated by distinct dorsal and lateral grooves. Dorsal plate is cleft through half its length (hence the name, *bifidus*) and the lateral lobes overlap somewhat; about as wide as long; wider than preceding segments. Abdomen and genital segment wider

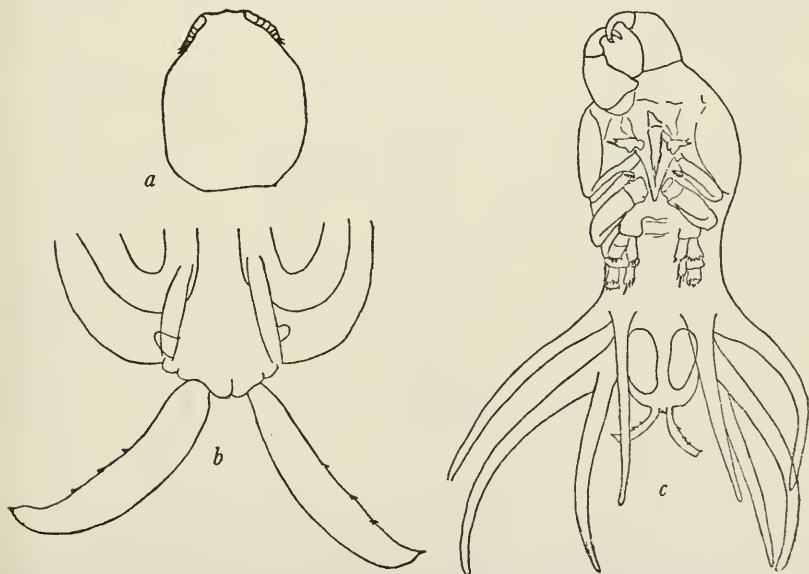


FIGURE 71.—*Lernanthropus amplitergum*, new species, male: a, Cephalothorax, dorsal view; b, posterior end; c, ventral view of body.

than long. Egg strings longer than the body, the right one, though incomplete, containing 204 eggs. Caudal rami leaflike, acutely pointed, and longer than the abdomen and genital segment combined.

First antennae partly concealed by lateral lobes, apparently 6-segmented; basal segment widest. Second antenna stout; terminal claw half as long as preceding segment, with a short blunt spine near its base. Second maxilla small, partly concealed by lateral lobes. Maxilliped smaller than second antenna.

First and second legs biramose; rami 1-segmented. First leg with elliptical endopod and with one long terminal seta; exopod bearing five stout spines and smaller spines between these. Second leg with one long endopod and several shorter setae, ciliated along

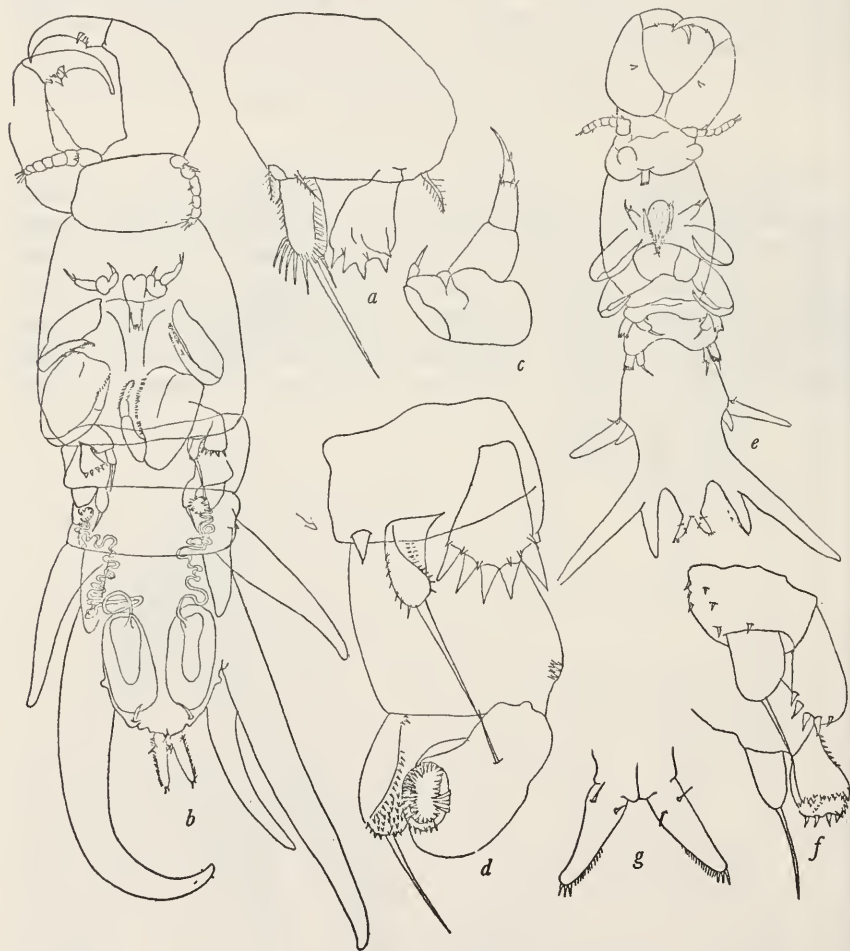


FIGURE 72.—a-d, *Lernanthropus bifidus*, new species: a, Second leg of female; b, ventral view of entire male body; c, first maxilla; d, first and second legs; e-g, *Lernanthropus hiatus*, male: e, Ventral view; f, first and second legs; g, caudal rami.

margins; exopod with four strong terminal spines and others on posterior surface. Third legs flat, biramous; exopod rhomboidal, endopod three times as long and pointed. Fourth legs narrower, biramous. Legs 3 and 4 extend beyond dorsal plate posteriorly.

Measurements: Length 4.8 mm.

*Male*.—Cephalothorax slightly wider and almost as long as the remainder of the body; both ends squarely truncated. Genital segment slightly narrower than preceding with two red spermathecae and two setae just posterior to them. Caudal ramus four times as long as wide, setose on lateral margins, bearing two short terminal setae, and two ventrally near the base.

First antennae 6-segmented. Second antennae longer and stouter than that of female; with two stout spines on hook near its base and several minute spines between these. First maxilla with two terminal setae and some smaller terminal setae, also a basal seta. Second maxilla with hook, spinulose near tip and bearing two larger spines. Maxilliped stout, spinulose along margin of penultimate segment opposite terminal hook, with a spine near tip of hook.

First leg with the exopod bearing five spines; endopod setose on margins and ending in a long seta. Second leg with exopod ending in a spinulose sucker; the endopod setose medially on basal segment and bearing a long terminal seta. Third leg biramous, endopod about one-third as long as exopod and mostly dorsal to the genital segment. Right fourth leg uniramous (an abnormality) and left leg biramous; the endopod three-fifths as long as exopod; the whole leg extends half its length beyond the caudal rami.

Measurements: Length 2.2 mm.

*Types*.—Female, U.S.N.M. No. 88640; male, U.S.N.M. No. 88542.

*Host*.—Two females and a male were taken from the gills of muttonfishes, *Lutianus analis* (Cuvier and Valenciennes).

*Remarks*.—This species resembles Wilson's (1932) *L. longipes*, but it has the posterior dorsal plate of the female more deeply cleft; the fourth legs as not so long as in that species. The armature of the appendages also differs considerably. This species is much smaller.

**LERNANTHROPUS HIATUS, new species**

FIGURE 72, e-g

*Male*.—Body short (1.7 mm.); cephalothorax nearly half as long as remainder of body. The caudal rami do not reach as far back as the endopod of the fourth leg; they are armed above with small setae near their bases and tipped with three small setae.

First antenna 6-segmented. Second antenna stout, the terminal hook bearing two small spines and the preceding segment with one short spine. Mouth tube slender, triangular. First maxilla with two stout terminal setae, one of which is three times the length of the other; wide space (0.25 mm.) between the antennae and the first maxillae. Second maxilla about two-thirds as large as maxilliped; hooks of both smooth.

First leg with basipod with several acute spines, with 1-segmented exopod that bears five terminal spines; endopod with a long terminal seta. Second leg with exopod terminating in a sucker armed with large and small spines; endopod with one terminal seta. The posterior part of the body shows no evidence of segmentation. The third legs have an endopod which is less than one-fourth as long as the exopod; that of the fourth leg is less than half the length of the exopod.

*Female*.—Unknown.

*Type*.—U.S.N.M. No. 88560.

*Host*.—A single male taken from the gills of the long-finned albacore, *Germo alalunga* (Gmelin).

*Remarks*.—This male differs from other species in the genus in having a very wide space between the antennae and the mouth tube and the first maxillae (hence the name *hiatus*), in the arrangement of spines on second antennae, and in the arrangement of the setae on the caudal rami. It appears to be closest to Steenstrup and Lutken's (1861) *L. konigii* but it differs from that species in the more slender body, especially in the fewer segments in the first antenna, the spines on the second antenna, and the spinous sucker on the exopod of the second leg.

#### LERNANTHROPUS SPICULATUS Wilson

*Lernanthropus spiculatus* WILSON, Proc. U. S. Nat. Mus., vol. 44, p. 233, pl. 38, figs. 185-189, 1913.

One female was taken from a gill of a lane snapper, *Lutianus synagris* (Linnaeus).

#### LERNANTHROPUS LONGILAMINA, new species

##### FIGURE 73

*Female*.—Body stocky, the dorsal plate wider and longer than remainder of body. Two prominent lateral lobes at anterior end, which cover the extended second antennae almost to the hooks (fig. 73, *d*), two deep lateral constrictions behind the cephalothorax. Egg strings projecting a little beyond the dorsal plate, in the type bearing 50 and 51 flat eggs.



First antenna 6-segmented, hidden beneath head lobes. Second antenna large and strong; terminal hook sharply bent, two small spines near its middle. First maxilla ciliate at tip and bearing one seta at base. Mouth tube slender and triangular. Second maxilla less than half as large as maxilliped; the latter spinulose where its terminal hook meets the preceding segment.

First leg with a somewhat spinulose basipod; exopod with five terminal spines; endopod with a setose margin and a long terminal seta. Second leg with a spinulose tip on the exopod and a single seta on the endopod. Third leg flat, biramose, and extended ventrally or laterally; rami unsegmented, wider at tip than at base, and truncate. Fourth leg with two short, cylindrical, tapering rami not quite reaching end of dorsal plate, lateral ramus ending in a short, sharp, laterally directed spine. Genital segment twice

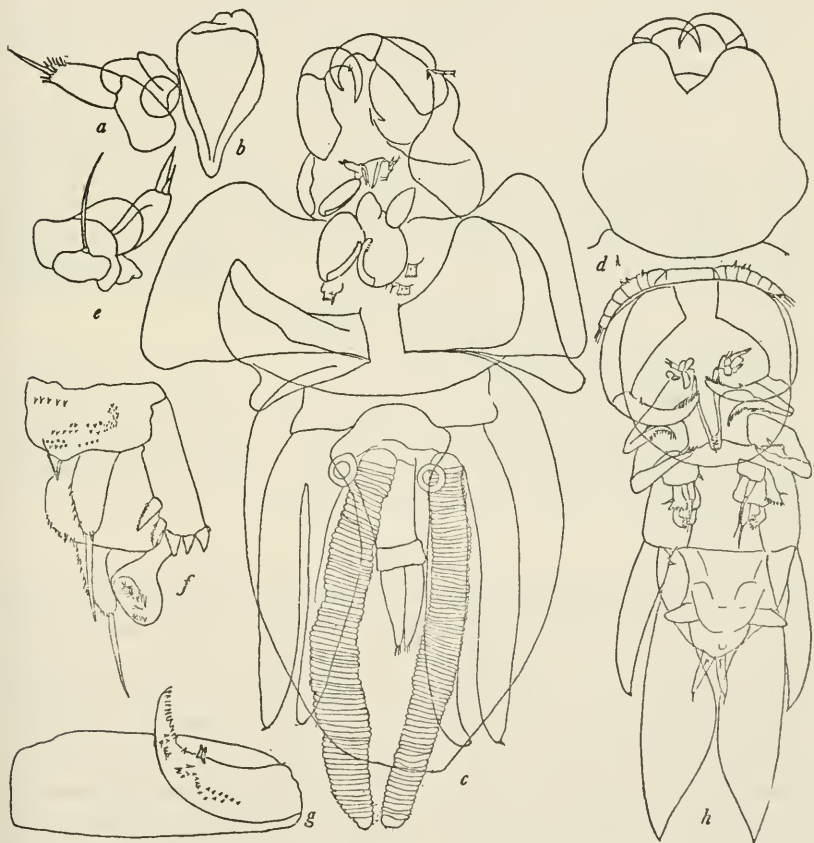


FIGURE 73.—*Lernanthropus longilamina*, new species: Female: *a*, First maxilla; *b*, mouth tube; *c*, ventral view; *d*, dorsal view of cephalothorax and second antennae. Male: *e*, First maxilla; *f*, first and second legs; *g*, maxilliped; *h*, ventral view.

as wide as long, with rounded lateral angles, wider in front than behind. Abdomen 2-segmented; first segment three times as long as wide; second segment one-fourth as long as first. Caudal rami slender, tapering, twice as long as genital segment; tipped with three short setae.

Measurements: Length, 3 mm.

*Male*.—Front of head straight, without lobes. Cephalothorax slightly wider and shorter than remainder of body, from which it is sharply separated laterally by incisions; covered dorsally by an elliptical plate. Second to fourth thoracic segments wider than genital segment, which is about as long as the remainder of the thorax. Anal papillae setose, as are the caudal rami distally.

First antenna 6-segmented; at front of head. Second antennae larger than those of female; terminal hook curved, spinulose at tip. Mouth tube long and slender. First maxilla with a long basal seta and 2 terminal setae. Second maxilla with spinulose terminal hook. Maxilliped slender, not much larger than second maxilla.

First legs spinulose on basipod; exopod with five terminal spines; endopod setose on median border, with one terminal spine. Second legs with exopod ending in a circular spinose disc; the basipod and endopod setose medially, the latter with a single terminal spine. Third and fourth legs flat, uniramous, leaflike, with pointed tips; the fourth about twice as long as the third, extending far beyond the caudal rami, which are slender, one-fourth as long as the fourth legs, and tipped with a single seta.

Measurements: Length, 2.2 mm.

*Types*.—Female, U.S.N.M. No. 88555; male, U.S.N.M. No. 88556.

*Hosts*.—Three females and one male taken from the gills of sheepshead, *Archosargus probatocephalus* (Walbaum), and seven females from the saucer-eyed porgy, *Calamus calamus* (Cuvier and Valenciennes).

*Remarks*.—This species is like Wilson's (1922) *L. chlamydotus* and *L. penulatus* in having a long dorsal plate, but it differs from them in having frontal lobes in the female, in the shape of the dorsal plate, and in the shape and armature of the mouth parts. The frontal lobes are like those of *L. caudatus*, but the dorsal plate is quite different from that species. It most closely resembles *L. pagelli* Krøyer (1863), but it differs in the greater spinosity of the mouth parts, the shape of the male and female abdomens, and caudal rami. It also resembles *L. pupa* Burmeister (1833), but it differs in the armature of the mouth parts, in the character of the first maxillae, the armature of the exopod of the second legs, and the caudal rami, and in its smaller size.

## Family DICHELESTHIIDAE

## Genus HATSCHEKIA Poche

## HATSCHEKIA ALBIRUBRA Wilson

*Hatschekia albirubra* WILSON, Proc. U. S. Nat. Mus., vol. 44, p. 239, pl. 41, figs. 209–215, 1913.

Five females were taken from the gills of gray snappers, *Lutianus griseus* (Linnaeus).

## HATSCHEKIA OBLONGA Wilson

*Hatschekia oblonga* WILSON, Proc. U. S. Nat. Mus., vol. 44, p. 242, pl. 42, figs. 222–226, 1913.

Six females were collected from the gills of gray snappers, *Lutianus griseus* (Linnaeus), and one from a gill of a schoolmaster, *L. apodus* (Walbaum).

## HATSCHEKIA LINEARIS Wilson

*Hatschekia linearis* WILSON, Proc. U. S. Nat. Mus. vol. 44, p. 246, pl. 44, figs. 240–246, 1913.

Twenty-six females came from the gills of margatefishes, *Hæmulon album* Cuvier and Valenciennes; 11 from blue-striped grunts, *H. sciurus* (Shaw); and 15 from barred grunts, *Conodon nobilis* (Linnaeus).

## HATSCHEKIA INSOLITA Wilson

*Hatschekia insolita* WILSON, Proc. U. S. Nat. Mus., vol. 44, p. 245, pl. 42, figs. 227–232, 1913.

A female came from a gill of a rock hind, *Epinephelus adscensionis* (Osbeck).

## HATSCHEKIA ANGULATA, new species

FIGURE 74, *a–g*

*Female*.—Sides of head produced into triangular, rounded lobes. Body behind head triangular, widest near the front, anterolateral angles rounded; posterior end truncate with rounded angles; two segments indicated by lateral indentations and cross divisions. Carapace widest in the middle, constricted somewhat just behind middle; posterior margin rounded at corners and slightly indented in middle. Genital segment and abdomen fused. Lobes at sides extend beyond abdomen. Caudal rami minute and armed with a single seta. Eggs large, 9–11, 15–16 in a string.

First antenna 6-segmented, sparsely setose. Second antenna has terminal hook with a swollen base. Mouth tube slightly wider than long. Maxilliped slender, with a double terminal hook.

Legs close together; not visible in dorsal view; arising from narrow ventral laminae. First leg with one spine on basipod and two spines on terminal segment; endopod with four apical spines; endopod with one spine on proximal segment and three on distal segment. Second leg with one spine on proximal segment of exopod and three on distal segment; endopod with one spine on basal segment and four on distal segment.

Measurements: Whole body 0.6 mm.; head 0.15 mm.; thorax and abdomen 0.58 mm.; width of whole body 0.9 mm.; head 0.3 mm.; thorax 0.4 mm.

*Male*.—Unknown.

*Type*.—U.S.N.M. No. 88518.

*Hosts*.—Six females were taken from the gills of the black angel-fish, *Pomacanthus arcuatus* (Linnaeus) and three from the French angelfish, *P. paru* (Bloch).

*Remarks*.—This species resembles Wilson's (1913) *H. uncata* and *H. insolita*, but it differs in the shape of the head, the length of the caudal rami, the greater number of eggs in the egg-strings, the double hook at the distal end of the maxilliped, and the shape of the body.

#### HATSCHEKIA PARVA, new species

FIGURE 74, h-k

*Female*.—Head a little wider than remainder of body (0.17–0.14 mm.) and about one-fourth as long, truncate and with median notch in front, tapered a little and rounded behind. First and second legs in plain view, as they protrude laterally. Eggs large, 4–6 in a string.

First antenna 3-segmented and somewhat setose. Second antenna long, constricted at the proximal third of its basal joint; terminal hook sharply bent at its distal third and sharp. Mouth tube far back on head behind bases of maxillipeds, rectangular with rounded corners, slightly longer than wide. First maxilla small, with one short seta. Maxillipeds with wide second segment, a narrow segment distal to that, and a short slightly bifid terminal hook.

Both pairs of legs are biramous. First leg with exopod 2-segmented and armed with two plumose setae; endopod 2-segmented, with two setae on the tip of the distal segment. Second leg with both rami 2-segmented; each segment of the exopod has one ter-



minal seta; the second segment of the endopod bears one long and one short seta. The caudal rami are indented on the median-distal angle, bear two terminal setae and are about one-tenth the length of the postcephalic body. The egg strings are not attached directly to the genital segment but are appended to strings.

Measurements: Length 0.72 mm.

Male.—Unknown.

Type.—U.S.N.M. No. 88529.

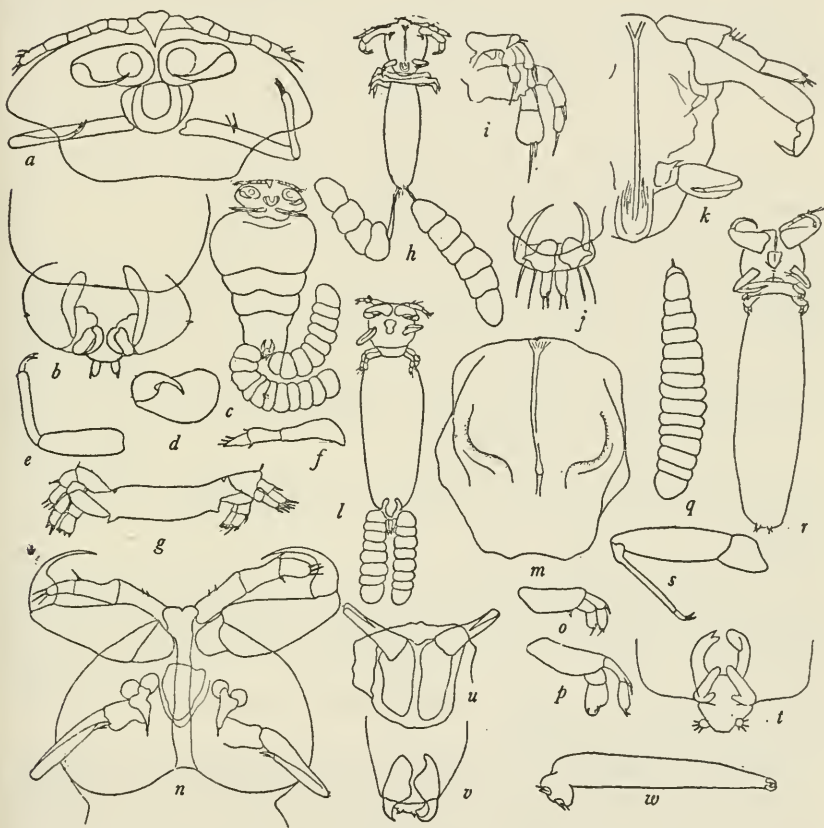


FIGURE 74.—a-g, *Hatschekia angulata*, new species, female: a, Ventral view of head; b, posterior end; c, ventral view of body; d, second antennae; e, maxilliped; f, first antenna; g, first and second thoracic segments with legs. h-k, *Hatschekia parva*, new species, female: h, Ventral view; i, first and second legs; j, posterior end; k, ventral view of left side of head. l-m, *Hatschekia exigua*, new species: l, Ventral view of female; m, dorsal view of cephalothorax. n-t, *Hatschekia amplifica*, new species, female: n, Ventral view of head; o, p, first and second legs; q, egg string; r, female ventral view; s, maxilliped; t, posterior end. u-w, *Hatschekia* sp., female: u, Ventral view of head; v, posterior end; w, whole body.

*Host*.—Three females, one with egg strings, were taken from the gills of a hogfish, *Lachnolaimus maximus* (Walbaum).

*Remarks*.—This species is quite different from *H. linearis*, which Wilson (1913) described from the hogfish. It more nearly resembles his *H. iridescens*, but it also differs from that species in shape of the head, the shape of the second antennae, the position and armature of the swimming legs, the shape and armature of the caudal rami, and the nature of the egg strings. The shape of the head and the second antenna are like those of *H. pygmaea* T. and A. Scott (1913), but the setation of caudal rami, antennae, and legs differ, as does the number of eggs.

HATSCHEKIA EXIGUA, new species

FIGURE 74, *l, m*

*Female*.—Head about one-fourth of total length, slightly narrower than body, with lateral margins expanded into low blunt lobes somewhat posterior to the middle. First two segments of thorax narrower than regions anterior and posterior to them and very short. First and second legs visible at sides of body. Cephalothoracic plate almost straight with a shallow antero-median notch, two lateral protuberances just anterior to the middle, and an incurved posterior margin. Postcephalothoracic portion of body without any trace of segmentation, widest at the anterior third, sharply tapered at the posterior end. Caudal rami minute, more than twice as long as wide, with one long and three short terminal setae.

First antenna 3-segmented, with 0, 2, and 4 setae. Second antenna with basal segment narrow in its middle; terminal hook large at base, sharply bent, and acute. Mouth tube in front of maxillipeds, wider at base. Maxillipeds with second segment wide, with curved margins; distal segment slender, with a terminal spine that has a serrate margin.

First legs biramous, with slender rami. Second legs biramous; basipod with a terminal seta; exopod 2-segmented, with a long and a short terminal seta; endopod 2-segmented, with a terminal circle of about seven short spines. Eggs large, 8–10 in a string.

Measurements: Length of body 0.93 mm.; length of cephalothorax 0.21 mm.

*Male*.—Unknown.

*Type*.—U.S.N.M. No. 88531.

*Host*.—Three females were taken from the gills of a squirrelfish, *Holocentrus ascensionis* (Osbeck).

*Remarks*.—This species resembles *H. oblonga* Wilson (1913), but it differs in the smaller number of segments in the first an-

tenna, in the shape of the cephalothorax, second antennae, and maxillipeds, in the smaller body, in the well differentiated first and second thoracic segments. It also resembles somewhat *H. parva*, described in this paper, but it differs from that species in the shape of the cephalothorax, in the shape of the posterior end, in the extent to which the first and second legs protrude laterally, in the comparative width of the cephalothorax and the rest of the body, in having smaller second antennae, and in the more anterior position of the mouth tube. It differs from *H. harkema* Pearse in the shape of the head, in the position and armature of the second antennae, legs, and caudal rami. The shape of the head and body are somewhat like those of *H. longibrachium* Yamaguti (1939), but the first antennae, caudal rami, and legs differ in their setation. The species is named *exigua* because of its small size.

## HATSCHEKIA AMPLICAPA, new species

## FIGURE 74, n-t

*Female*.—Carapace wider than long, rounded in front, indented behind, a little wider than remainder of body. No neck, sides of body nearly parallel and posterior almost as wide as anterior. Posterior end truncate with caudal rami little longer than wide and armed with four setae. The legs are visible at the sides of the thorax.

First antenna 3-segmented, rather stout; basal segment with two minute spines, second with two setae; third with four terminal setae. Second antenna large, terminal hook with large base, slender acute tip, and no accessory spines. Mouth tube rather far forward, wider at the anterior end. First maxilla a simple spine with a bilobed base. Maxilliped slender, with double terminal hooks.

First leg biramous; exopod 2-segmented, terminal segment tipped with three short spines; endopod 2-segmented with a long and a short terminal spine; a small seta is present medial to the endopod. Second leg biramous; first segment of exopod with terminal spine, terminal segment with a long and a short seta; endopod 2-segmented, terminal segment broad and armed with three very minute spines. One egg string contains 16 large eggs.

Measurements: Length 1.0–1.3 mm.; width of carapace 0.26 mm.; width of body 0.24 mm.

*Male*.—Unknown.

*Type*.—U.S.N.M. No. 88602.

*Host*.—Eight females were taken from the gills of the great barracuda, *Sphyraena barracuda* (Shaw).

*Remarks.*—This species resembles somewhat Wilson's (1913) slender *Hatschekia oblonga*, but it differs in the absence of a neck, the shape of the carapace, the armature of the legs, the length of the caudal rami, and in having double hooks on the maxillipeds.

HATSCHEKIA species

FIGURE 74, *u-v*

*Female.*—Two specimens were taken from the gills of a rock beauty, *Holocanthus tricolor* (Bloch), but both are so mutilated that it does not seem proper to assign to them a specific name.

Body slender, about seven times as long as wide. Frame for head rectangular. Second antenna with basal segment growing smaller distally; terminal hook curved and sharp pointed. Caudal rami minute, rough tipped and bearing one small seta; smaller than hooks on either side of them.

Measurements: Length 1.0 mm.; width 0.15 mm.

*Male.*—Unknown.

*Remarks.*—This species appears to differ from others in the genus in its minute caudal rami and the large hooks lateral to them.

Family EUDACTYLINIDAE

Genus KRØYERIA Beneden

KRØYERIA SPATULATA Pearse

*Krøyeria spatulata* Pearse, Journ. Elisha Mitchell Sci. Soc., vol. 64, p. 127, figs. 1-10, 1948.

Two females came from the gills of a sand shark, *Carcharias littoralis* (Mitchill).

Genus NEMESIS Risso

NEMESIS PILOSUS, new species

FIGURE 75

*Female.*—Cephalothoracic carapace elliptical, slightly longer than wide, pilose throughout ventral surface. First free thoracic segment a little longer than the two following, which are about the same length, each segment completely covered dorsally by a plate that overlaps the one behind it a little and laterally is somewhat enlarged and curved ventrally. The fifth segment is narrower than those preceding it; nearly twice as wide as long; dorsal plate does not extend laterally and hence does not curve ventrally. Genital segment not quite so long as and two-thirds as wide as fifth segment. Abdomen 3-segmented; first segment widest, first and



second about equal in length, shorter than third, caudal rami twice as long as wide, elliptical, with five terminal setae. Egg strings much longer than body, containing 66 and 72 eggs.

First antenna 14-segmented, the basal and distal segments longest. Second antenna small, with a long seta on the basal segment, which is two-thirds as long as the second segment; terminal hook with a swollen base that bears a seta, and two low tubercles on the inner margin. Second maxilla stout, with a short, strong, setose terminal hook. Maxilliped very large, terminal hook sharply bent near tip and bearing two short spines on inner margin.

Second leg biramous and rami 2-segmented; exopod with two setae on proximal segment, and six on the end of the distal; endopod with a spinulose distal margin on proximal segment, and two

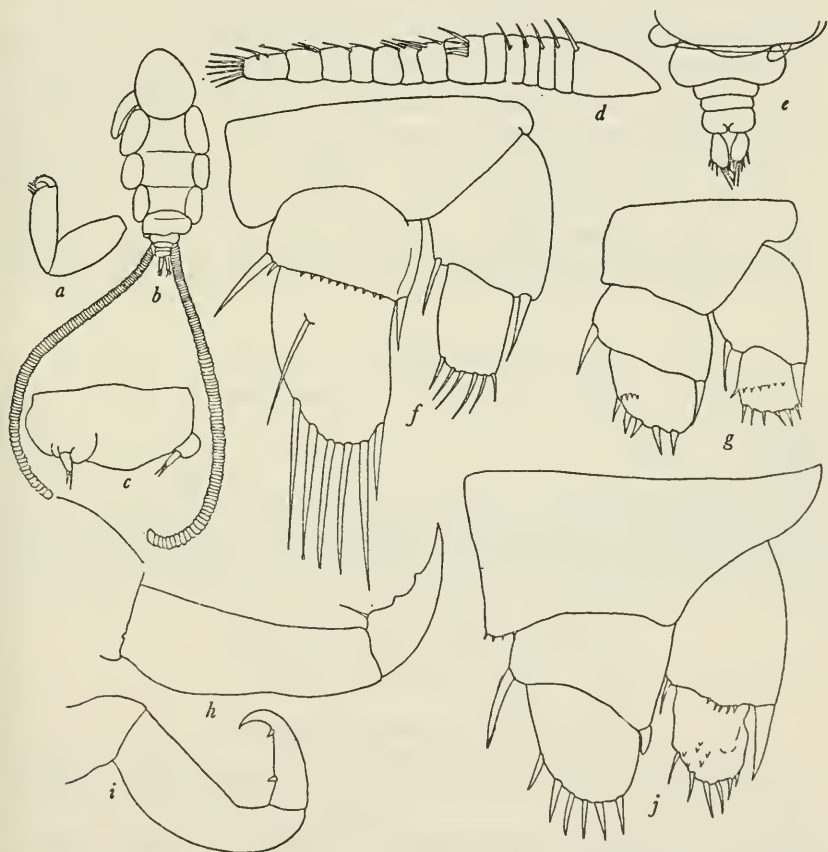


FIGURE 75.—*Nemesis pilosus*, new species, female: *a*, Second maxilla; *b*, dorsal view of body; *c*, genital segment and fifth legs; *d*, first antenna; *e*, posterior end; *f*, second leg; *g*, fourth leg; *h*, second antenna; *i*, maxilliped; *j*, third leg.

setae, distal segment, with one surface and six terminal setae. Third leg much like second but with shorter setae; margin of basipod and exopod spinulose. Fourth leg with a few small spines across middle of distal segments of both rami; both exopod and endopod with two spines on proximal segment, distal segments with six and four spines. Fifth leg uniramous, 2-segmented basal segment more or less globose; second segment tapering toward tip, which bears two setae.

Measurements: Length 3 mm.; carapace length 1.0 mm.; width 0.9 mm.

*Male*.—Unknown.

*Type*.—U.S.N.M. No. 88535.

*Host*.—A single female was taken from the gill of a sand shark, *Carcharias littoralis* (Mitchill).

*Remarks*.—This species differs from Wilson's *N. versicolor* (1913) and *N. atlantica* (1922) in the shape of the cephalothoracic carapace, which has no anterolateral projections, in the character of the terminal hooks of the second antenna and second maxilla, in the length and greater number of eggs in the egg strings, and in the size of the maxilliped and in the armature of its terminal hook. It differs from Wilson's (1932) *N. pallida* in the character of the fifth feet, the armature of the second maxillae, and the larger number of segments in the first antennae.

#### Genus LERNAEENICUS Richiardi

##### LERNAEENICUS LONGIVENTRIS Wilson

*Lernaeenicus longiventris* WILSON, Proc. U. S. Nat. Mus., vol. 53, p. 66, pl. 7, 1917.

Some females of this species were present in the bodies of some mullets, *Mugil cephalus* Linnaeus, shipped from Miami, Fla. These were not included in the summary at the beginning of this paper.

#### Family PSEUDOCYCNIDAE

##### Genus PSEUDOCYCNUS Sundevall

##### PSEUDOCYCNUS APPENDICULATUS Heller

*Pseudocygnus appendiculatus* HELLER, Reise der Oesterreichischen Fregatte *Novara*, vol. 2, pt. 3, Crustacea, p. 218, pl. 22, 1865.

Three females were collected from the gills of a common bonito, *Sarda sarda* (Bloch).

## Genus CYBICOLA Bassett-Smith

## CYBICOLA ELONGATA, new species

## FIGURE 76

*Female*.—Body more than nine times as long as wide, without segmentation. Head a little wider than remainder of body, with a shallow median sinus in front, rounded behind; length a little more than one-seventh of total length of body; narrower in front fourth. Thorax with lateral constrictions that separate the first two segments and swellings that indicate the third. Genital segment not distinct. Abdomen behind it not distinct, a little longer than wide. Caudal rami not so long as abdomen; tips rounded and bearing one long and two short setae.

First antenna 7-segmented; a seta on the basal segment and at least three at tip. Second antenna small, 3-segmented; terminal hook with a spine on inner margin. Mouth tube slender and conical. First maxilla with a small terminal hook and two strong setae. Second maxilla anterior to first, near base of mouth tube; small, slender, with curved terminal hook. Maxilliped enormous, covering most of ventral side of head, with lamellate outer margin on penultimate segment except where the terminal hook meets it; there it is smooth near the hook and farther proximal it is setose; a stout, short, spine at the medial base of the terminal hook, which is sharply curved.

First leg surrounded by, and first three legs associated with, lateral, finely papillose areas. First leg biramous, with a spine at the base and a spine on either side of the distal margin of the basal segment; exopod 1-segmented with four minute spines at tip; endopod uniramous, with a seta at tip; papillose area with a seta at posterior margin of disc that surrounds the appendage; another elliptical papillose area on the lateral margin of the body near the first leg. Second leg uniramous, flat, rounded at tip, with a row of striations on the lateral surface; papillose area lateral to it, oval, and larger than that with first leg. Third leg very small; the single segment with a small curved terminal hook. Fourth leg a seta that arises from a papilla.

Measurements: Length 5.3 mm.; length of head 0.7 mm.

*Male*.—Unknown.

*Type*.—U.S.N.M. No. 88538.

*Host*.—Three females were taken from the gills of a Spanish mackerel, *Scomberomorus maculatus* (Mitchill).

*Remarks*.—In his description of the genus (*Helleria*) *Cybicola* (1898a, p. 11; 1898b, p. 371) Bassett-Smith states that there are no fourth legs. From his figures and a comparison with my specimens my feeling is that he either overlooked the third legs or that

they were absent and he called the fourth legs the third. My species differs from his in the extent and shape of the papillose areas on the first, second, and third thoracic segments; the much longer



FIGURE 76.—*Cybicola elongata*, new species, female, *a*, Ventral view of body, *b*, first legs; *c*, second legs; *d*, third legs; *e*, fourth legs.



body; the lack of any trace of separation between the caudal rami, the abdomen, and the genital segments; and in the armature of the cephalic appendages.

## Suborder LERNAEOPODOIDA

### Family LERNAEOPODIDAE

#### Genus THYSANOTE Krøyer

#### THYSANOTE POMACANTHI Krøyer

*Thysanote pomacanthi* KRØYER, Naturh. Tidsskrift, ser. 3, vol. 2, p. 288, pl. 15, 1863.

Six females were taken from the gills of black angelfishes, *Pomacanthus arcuatus* (Linnaeus).

## Order ISOPODA

### Superfamily CYMOTHOIDEA

#### Family AEGIDAE

#### Genus ROCINELA Leach

#### ROCINELA SIGNATA Schioedte and Meinert

*Rocinela signata* SCHIOEDTE and MEINERT, Naturh. Tidsskrift, ser. 3, vol. 12, p. 399, pl. 13, fig. 3, 1879.

Six muttonfishes, *Lutianus analis* (Cuvier and Valenciennes), yielded one female; a sheepshead, *Archosargus probatocephalus* (Walbaum), carried another female; 6 saucer-eyed porgies, *Calamus calamus* (Cuvier and Valenciennes), carried 4 females on their gills and a male and a female in their mouths; among 14 queen triggerfishes, *Balistes vetula* Linnaeus, one carried a male on its fin and another a female on its gill. This species was the only isopod found on fishes.

### Superfamily BOPYROIDEA

#### Family BOPYRIDAE

#### Genus HEMIARTHURUS

#### HEMIARTHURUS SCHMITTI Pearse

*Hemiarthrus schmitti* PEARSE, Proc. U. S. Nat. Mus., vol. 81, art. 1, p. 3, figs. 15-21, 1932.

On more than 300 alpheid shrimps, *Synalpheus brooksi* Coutière, that came from a loggerhead sponge, *Spheciospongia vesparia*

(Lamarck), 4 males were attached to 8 females that were under the abdomen of their shrimp hosts.

Genus BOPYRO Pearse

BOPYRO CHOPRAE Pearse

*Bopyro choprae* PEARSE, Proc. U. S. Nat. Mus., vol. 81, art. 1, p. 1, figs. 1-14, 1932.

From the gill chambers of the same shrimps mentioned under *Hemiarthrus schmitti* two females and a male were collected.

Genus LEIDYA Cornalia

LEIDYA BIMINI, new species

FIGURE 77, a-i

*Female*.—Body compressed and distorted, longer than broad. Head not deeply set in thorax, rounded in front and behind, with two large lateral, oval discs. First antenna 3-segmented; the distal segment is narrowest and bears five strong setae. Second antenna 5-segmented; distal segment narrowest and shortest. All thoracic segments distinct; first five with delicate median ventral suckers. Thoracic legs stout; terminating in short claws; four distal segments minutely spinulose. Abdomen segments all separate; pleopods slender with digitate margins.

Measurements: Length 6.7 mm.; width 4.8 mm.; length of head 1.6 mm.; width 2.0 mm.

*Male*.—Body slender, 3.6 times as long as wide; head one-fourteenth of total length; fourth thoracic segment slightly wider than others; 13 segments behind the head; caudal rami 0.22 total length. First four segments of thorax transversely oblong with rounded corners, the remaining segments increasingly wider posteriorly until the fourth and fifth abdominal segments, which have laterally projecting processes. The thoracic and abdominal segments have ventral processes; the first of these is nearly spherical, the next four are elongated with rounded tips, the next four are wider and triangular, and on abdominal segments 2-5 these are armed with cross or concentric ridges. The five abdominal segments have posterolateral thickenings which have definite patterns, as shown in figures 77, c and d. The anal segment is a truncated, rounded pyramid, not sharply separated from the slender caudal rami, which are without spines or setae. The second abdominal segment has irregularly branched pigment cells and the three other anterior abdominal segments show a few small rounded pigment masses. The first antennae are 3-segmented and broad. The second antennae are 7-segmented; segments decreasing from base to tip and bear 0, 1, 2, 2, 7, 0, and 5 setae.

Measurements: Length 2.5 mm.; width 0.7 mm.

*Types*.—Female, U.S.N.M. No. 88573; male, U.S.N.M. No. 88573.

*Host*.—Three females and a single male were taken from the branchial chambers of a *Pachygrapsus transversus* (Gibbes).

*Remarks*.—This species differs from Leidy's (1855) *Leidya distorta* from *Uca pugilator* (Bosc), the only one previously described in this genus. The female is wider, her head is shorter, thoracic legs with better defined terminal claws, and a shorter abdomen. The male differs in the shape of the head and the body segments, the character of the chitinous lateral thickenings on the abdomen, the shape of the anal segment, and the character of the ventral papillae on the thoracic and abdominal segments. Leidy states that his male had 14 body segments. I have examined specimens of males from his host and find only 13 segments posterior to the head.

### Family CRYPTONISCIDAE

Genus CANCRION Giard and Bonnier

CANCRIION CAROLINUS Pearse and Walker

*Cancerion carolinus* PEARSE and WALKER, Proc. U. S. Nat. Mus., vol. 87, p. 10, fig. 12, 1939.

From 489 mud crabs *Panopeus herbstii* H. Milne-Edwards, 12 females of this species were taken from the body cavity.

## Order CIRRIPEDIA

### Suborder LEPADOMORPHA

Genus OCTOLASMIS J. E. Gray

OCTOLASMIS FORRESTI (Stebbing)

*Octolasmis forrestii* STEBBING, Ann. Mag. Nat. Hist., ser. 6, vol. 13, p. 444, pl. 15, 1894.

This barnacle was quite abundant in the gill chambers and to some extent on the mouth parts of spiny lobsters *Panulirus argus* (Latreille). Four hosts averaged about 175 each.

OCTOLASMIS UNCUS, new species

FIGURE 77, k

The capitulum is compressed, triangular with basal angles rounded and the tip slightly bent toward the occludent side; about three-fourths as wide as long. The occludent margin is curved, but much less than the carinal margin.

The scutum is calcified in two segments; occludent segment curved and pointed at both ends and gradually tapered; carinal segment bifid at the distal end but otherwise much like the occludent segment. Tergum large, stout and bent to form strong sharp hook on the carinal side, therefore the specific name *uncus*.

The carina is moderately curved above, strongly so near the base.

The peduncle is a little longer than the capitulum, cylindric, and wrinkled transversely.

*Type*.—U.S.N.M. No. 88582.

*Host*.—Six specimens were collected from the gill chambers of two stone crabs, *Menippe mercenaria* (Say).

*Remarks*.—This species differs from *Octolasmis geryonophila* Pilsbry (1907). Pilsbry's specimens in the National Museum show some variation in the hook on the tergum but in no case is it as long, as sharp, or as sharply bent as in the present species. Also the two segments of the scutum are narrower, closer together proximally, and the carinal segment is bifid distally in the present species.

OCTOLASMIS BREVIS, new species

FIGURE 77, j

The capitulum is compressed, more than three-fourths as wide

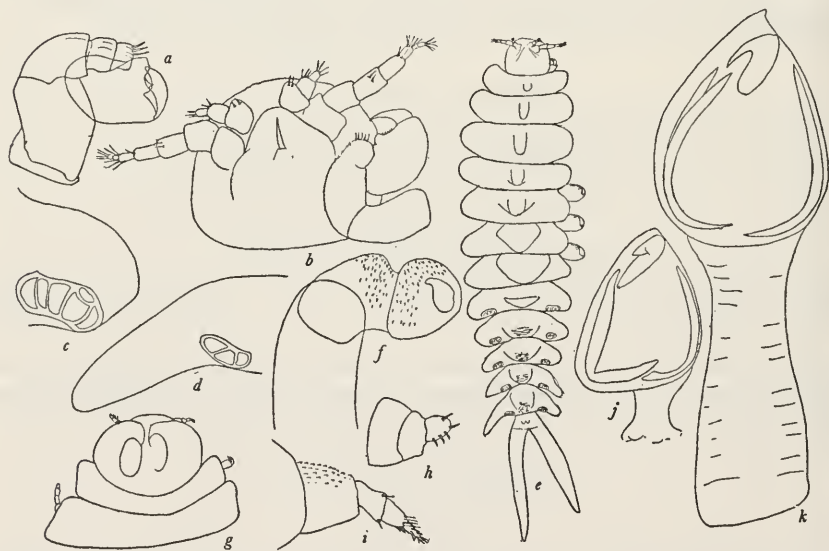


FIGURE 77.—a-i, *Leidyia bimini*, new species: Male: a, Seventh leg; b, ventral view of head and left first leg; c, right lateral portion of first abdominal segment; d, left lateral portion of fifth abdominal segment; e, entire body of male. Female: f, Third leg; g, dorsal view of head and first two thoracic segments; h, first antenna; i, second antenna; j, *Octolasmis brevis*; k, *Octolasmis uncus*.



as long, and triangular. Occludent margin straighter than the carinal.

Scutum calcified in two segments; occludent segment thin, wider than the carinal, bent at an angle of less than  $90^\circ$ , carinal segment slender and gradually curved, flattened a little where it meets the occludent. Tergum large, slightly bifid at the proximal end, with a strong, recurved hook near its distal end; this hook about one-fourth as long as the tergum. Carina tapered and curved distally; proximal edge rather straight. Peduncle less than half as long as capitulum, nodulose and spreading proximally.

Measurements: Length 3.2–3.8 mm.; width of capitulum 1.6–2.0 mm.; length of capitulum 2.00–2.4 mm.; length of stalk 1.2 mm.

*Type*.—U.S.N.M. No. 88580.

*Host*.—From the gill chambers of 186 mud crabs *Panopeus herbstii* H. Milne-Edwards, 32 of these parasites were collected. Some of these bore ovate eggs.

*Remarks*.—This species resembles *O. geryonophila* Pilsbry (1907) and *O. mülleri* (Coker (1902)), but it differs from them in having a shorter peduncle, a longer and stouter hook, and a bifid proximal end on the tergum. Also the actual segments come close together and even overlap, proximally, in the present species.

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## NEW AND LITTLE-KNOWN BEES OF THE FAMILY ANDRENIDAE FROM CALIFORNIA<sup>1</sup>

By P. H. TIMBERLAKE

The andrenid fauna of California is extremely rich in species, and many of these are new to science. In the present contribution, 22 species or subspecies of *Andrena* and two species of *Megandrena* are described as new, and several old species are redefined, all in the family Andrenidae.<sup>2</sup> The species here considered are nearly all represented in a collection of Andrenidae belonging to the United States National Museum and sent to me for study in the fall of 1945. Included in this collection were the types of numerous manuscript species of Viereck, and a few of his names have been adopted in the present paper.

### Genus *ANDRENA* Fabricius

#### *ANDRENA* (*TRACHANDRENA*) *CALIFORNICA*, new species

This species belongs in a small group of *Trachandrena* having the hair on outer side of the hind basitarsus more or less blackened, or at least appreciably darker than the scopal hair of tibia. It differs from *A. limarea* Viereck in the duller mesoscutum and in the more broadly depressed and more densely punctured second tergite. From *A. quintiliformis* Viereck it differs in the dull mesoscutum, with the hair much finer and entirely light, and in the less

<sup>1</sup> Paper No. 644, University of California Citrus Experiment Station, Riverside, Calif.

<sup>2</sup> Hymenoptera: Apoidea.

densely punctured abdomen. It also differs from most other species of *Trachandrena*, including the two mentioned above, in having the pygidial plate gently convex, without a median embossed area.

*Female*.—Black, the apex of mandibles and small joints of tarsi reddened. Tegulae testaceous-brown. Wings subfuliginous, with stigma and subcosta piceous and the other nervures more reddened. Pubescence of head dirty white, becoming brownish on apical margin of clypeus and on labrum, and fulvous on lower edge of mandibles. Facial foveae brownish ochreous. Hair of thorax fulvous-red, changing to ochreous on propodeum and underparts, but the red covering tubercles and area just below base of forewings. This hair rather fine and moderately dense on notum and longer and sparser on the pleura. Abdomen without hair bands, the first four tergites with thin, pale-ochreous or whitish hair at the sides. Apical fimbria dusky fulvous-red, more or less darker than hair of notum, or sometimes brownish, especially in worn specimens. Hair of legs ochreous, the flocculus of hind trochanters more whitish, and the scopa of hind tibiae clear fulvo-ochreous. Hair of front and middle tibiae and tarsi, of apex of hind femora above, of base of hind tibiae on outer side, and of hind basitarsi more or less dark brown to fuscous. Process of labrum broader at base than long and narrowed to the rounded apex. Clypeus with strong, very close punctures and provided with a more or less distinct, smooth median ridge. Frons densely, substriately punctured. Facial foveae broad above and gradually narrowed almost to a point below, where they are separated from the eye margin by a narrow shining space. Mesonotum dull, closely and moderately coarsely punctured. Basal area of propodeum with irregular, more or less wavy rugae. Abdomen polished, moderately densely punctured, with the punctures of the apical depression of tergites 2 to 4 a little finer and more separated than those of the basal elevation. Punctures of tergite 1 well separated on the disk and absent on basal declivity. Tergite 2 depressed about three-fifths in the middle. Tergites 2 and 3 provided with a rather strong, groovelike basal transverse impression. Pygidial plate narrowly subtruncate at apex and gently convex on the disk. Length 10–11 mm.; anterior wing 8–8.3 mm.

*Male*.—Black, with tarsi dull ferruginous and apex of ventrite 6 clear ferruginous. Pubescence ochreous or fulvo-ochreous, nearly uniformly colored throughout, and rather long and dense on head and thorax. Hair of abdomen rather short and erect on disk of tergite 2 to 5, becoming a little dense and depressed at sides of apical margin of 2 to 4, and longer and brighter colored on tergites 6 and 7 and usually also across apical margin of tergite 5 (but



older and worn specimens show little or no evidence of this subfasciate condition). Face, including clypeus, closely punctured. Frons finely, substriately rugose. Thorax dull, the mesonotum with small, close punctures. Sides and posterior face of propodeum finely rugose, the sculpture finer than that of basal area. Abdomen finely, moderately closely, and rather weakly punctured. Tergite 2 depressed a little less than one-half. Basal process of labrum much broader than long and broadly concavo-truncate at apex. Third antennal joint as long as thick at apex and about one-half as long as following joint. Flagellum dull. Length 8-9 mm.; anterior wing 6.8-7.8 mm.

The male of this species is similar to that of *A. quintiliformis* Viereck, but has the antennae slightly longer, mesoscutum duller, with finer, less separated punctures, and abdomen hardly fasciate and less strongly and less densely punctured.

*Types*.—U. S. N. M. No. 59272. Holotype (female), Mill Creek, 4,400 feet, San Bernardino Mountains, Calif., on *Cryptantha intermedia*, May 30, 1938; allotype, Mill Creek, 6,000 feet, on *Arctostaphylos patula*, April 28, 1946 (Timberlake).

Paratypes, in the collection of the University of California at Riverside and Berkeley: 2 females, Mill Creek, 4,800 feet, at flowers of *Quercus dumosa*, May 13, 1940; 5 males, Mill Creek, 6,000 feet, on *Ceanothus cordulatus*, May 30, 1939, and May 21-22, 1940; 3 females, Tetley Park, 4,500 feet, San Bernardino Mountains, on *Horkelia parryi*, July 7, 1935; 5 males, Tetley Park, on *Salix laevigata* and at flowers of apple, May 15, 1937; 1 male, Tetley Park, on *Nemophila rotata* var. *integrifolia*, May 19, 1941; 1 female, Skyforest, San Bernardino Mountains, on *Horkelia parryi*, July 14, 1935 (Timberlake); 1 female, Miami Ranger Station, Mariposa County, on *Arctostaphylos*, May 18, 1942 (A. J. Walz); 1 female, same locality, June 4, 1942 (E. G. Linsley); 2 females, Oakhurst, Madera County, June 1, 1942 (Linsley) and on *Ceanothus*, June 5 (Walz); 3 females, Bass Lake, Madera County, May 30 and June 3, 1942 (Linsley); and 1 female, Herman Mountains, 500 feet, Santa Cruz County, June 13, 1912 (G. A. Coleman).

ANDRENA (TRACHANDRENA) CALIFORNICA WICKHAMI, new subspecies

At first glance the hair on the hind basitarsus of *wickhami* appears to be light colored, but careful scrutiny shows that it is actually darker than the scopal hair of the tibia. This subspecies, therefore, shows some similarity to *A. grandior* Cockerell but differs in having the mesonotum duller and densely punctured, the abdomen less densely punctured, with the basal impression of tergites 2 and 3 less strong and the basal elevation of each

segment less ridgelike. The manuscript name given by Viereck has been adopted for this subspecies.

*Female*.—Agreeing with *A. californica californica* in most characters, but hair of front and middle tibiae and tarsi and of hind basitarsi more or less pale brownish, and having only a trace of darker hairs near the knee plate at base of hind tibiae; stigma and nervures also dark ferruginous, with only the subcosta piceous. Length 8.5–9 mm.; anterior wing 7.5–7.8 mm.

*Types*.—Holotype, female (U.S.N.M. No. 28534), Dunsmuir, Siskiyou County, Calif., early June (Wickham); paratype (female) Mendocino County (E. R. Leach).

ANDRENA (PTERANDRENA) PLUMISCOPA, new species

A *Pterandrena* of a dark-green color and a very dull sculpture. Other green or blue-green *Andrena* of the Pacific coast, with a plumose scopa, such as *complexa* Viereck, *suavis* Timberlake, and *francisca* Viereck, have narrow facial foveae, a looser tibial scopa, and no light face marks in the male. These are referred more properly to *Ptilandrena*.

*Female*.—Dark green, this color being most distinct on frons, vertex, mesonotum, and tergum of abdomen. Clypeus and labrum black. Legs and venter dark brown to nearly black, the second ventrite with a greenish tinge. Tibial spurs pale testaceous. Mandibles dark red on apical half, piceous at base. Flagellum broadly ferruginous beneath beyond its second joint. Tegulae testaceous-brown at apex and dark toward base. Wings strongly dusky, the stigma and nervures dark ferruginous, the subcosta blackish. Pubescence pale ochreous or pale brownish, becoming more whitish on face, cheeks, and underparts of thorax; that on the mesonotum moderately dense and somewhat shorter. Floccus of propodeum long, curled, plumose, strongly descending along anterior margin of the pleuron; surface of propodeal pleura otherwise with a few scattered long erect hairs. Hair of abdomen whitish, moderately dense, short and erect on tergites 3 and 4, thence gradually lengthened toward the base. Hair at apex of tergites 2 to 4 depressed, forming narrow pale fasciae. Apical fimbria and tuft of hair at apex of hind femora above dark seal brown. Hair of femora white, the flocculus of hind trochanters pure white, very long, and ample. Hair on outer side of front and middle tibiae tinged with brown. Scopa of hind tibiae short and compact, with fine, soft, distinctly plumose hair, that along dorsal margin less than half as long as width of tibia. Scopal hairs white, becoming dark chocolate brown above, then blackish at base. Facial foveae whitish, but seal brown at upper end. Head

distinctly wider than long, with inner orbits of eyes slightly converging below. Facial foveae covering about three-fourths of space between eye and lateral ocellus, somewhat narrowed below, where they reach a little below level of antennae. Basal process of labrum with strongly diverging sides, the truncate or truncate-emarginate apex about two-fifths as wide as the base. Mandibles not emarginate within, the explanate margin on outer side near base very narrow. Third antennal joint barely longer than the next two together. Middle basitarsi dilated and considerably wider than the hind pair. Basal nervure before the nervulus. Stigma narrow. Second submarginal cell quadrate, less than half as long as third, and receiving the recurrent nervure a little beyond the middle. Head and thorax very finely granular-tessellate, the frons minutely indistinctly striate. Face below antennae with fine, close, indistinct punctures, but those on middle of clypeus much coarser and somewhat separated. Clypeus with a median ridge. Mesoscutum closely and indistinctly punctured. Basal area of propodeum small, minutely tessellate, and slightly roughened at base. Abdomen a little more shining than thorax, finely and very obscurely punctate. Length 9–10 mm.; anterior wing 6–6.4 mm.

*Male*.—Much like the female except in the creamy-white or pale-yellow face marks, which cover the clypeus and broad space between clypeus and eye. Anterior margin of clypeus and two dots on disk, black. Flagellum broadly ferruginous beneath except at base. Inner orbits distinctly convergent below. Cheeks moderately wide and strongly receding behind. Mandibles short, slightly curved, and dentate within near apex. Third antennal joint somewhat shorter than the next two together. Flagellum rather stout, with the middle joints nearly  $1\frac{1}{2}$  times longer than thick. Sculpture similar to that of female, but clypeus without a median ridge, a little shiny on anterior middle, and the punctures of face small, a little separated on middle of clypeus, and elsewhere indistinct. Pubescence a little thinner than in female, and not much shortened on mesonotum. Hair of abdomen about the same, except that the apical fasciae are very narrow. Venter with short, erect hair and a distinct fringe on the apex of segments 2 to 5. Hair at apex of abdomen a little brownish. Hair of legs rather short and whitish, that on inner side of tarsi pale ochreous. Sixth ventrite with a broad, rounded emargination at apex, the margin not reflexed. Latero-apical lobes (or parameres) of stipites with a broad triangular dilation on a little less than the apical half. Medio-apical lobes of stipites well developed and a little divergent. Sagittae short, moderately dilated and subangulate subbasally on each side, then gradually narrowed to a broad, blunt point and strongly



curved downward to end opposite the base of the expansion of the parameres. Length 8–10 mm.; anterior wing 5.8–6.4 mm.

*Types*.—U.S.N.M. No. 28533. Holotype (female) and allotype, Riverside, Calif., on *Cryptantha intermedia*, the female March 6, 1929, and the male March 26, 1934.

Paratypes in the collection of the Citrus Experiment Station: 2 males, Riverside, on same flower, March 15 and 26, 1934; 2 females, 3 miles west of Perris, on same flower, April 20, 1939; 3 females, 4 miles west of Perris, on same flower, March 27 and April 10, 1946; 1 female, The Gavilan, Riverside County, on same flower, April 10, 1946; 2 males, 4 females, Temecula, on same flower, except one female on *Platystemon californicus* and a pair taken in copula on ground, April 7, 1944 (all Timberlake). Paratypes in U. S. National Museum: U.S.N.M. No. 28533, 3 males, 15 females, San Francisco (J. C. Bridwell), which are undated except 3 taken April 13, 1913, and one at Lake Merced, May 5, 1912; 1 female, with abdomen missing, Los Angeles County (Coquillett); and 1 male, San Diego.

This is one of the species bearing a manuscript name given by Viereck. I have not observed the pollen-collecting habits of this bee. Only one female of those recorded above (one taken at San Francisco, April 13) had collected pollen. This pollen consists of very fine spherical grains of a dark-orange color.

ANDRENA (PTERANDRENA) ISOCOMAE, new species

Allied to *A. gardineri* Cockerell, but differs in the larger and broader facial foveae, in the slender teeth of basal process of labrum, the more shining mesoscutum, more strongly plumose tibial scopa, etc. The male differs from the Colorado species in having large lateral face marks, which are very small or absent in *gardineri*.

*Female*.—Black, the flagellum hardly reddened beneath. Claws ferruginous, the spurs testaceous yellow. Tegulae shining dark brown. Wings strongly dusky, the nervures and stigma dark ferruginous, the subcosta and inner margin of stigma blackish. Pubescence fulvo-ochreous, varying to whitish, rather dense on the notum of thorax and short on mesoscutum. Base and lateral margins of tergite 1 with thin hair, its apex and that of three following segments with a dense broad band of light pubescence. Disk of these tergites appearing nude, but bearing fine, short, erect hair. Scope of hind tibiae strongly plumose. Flocculus of hind trochanters ample, strongly curled. In specimens with whitish pubescence, the scopa of hind tibiae and apical fimbria of abdomen remain distinctly tinged with fulvo-ochreous. Facial



foveae pale ochreous, or whitish, broad and extending a little below antennae. Head distinctly broader than long. Anterior edge of mandible with a testaceous explanate margin near base. Process of labrum bidentate, the teeth subacute, generally longer than wide. Third antennal joint longer than the next two together. Clypeus more or less polished, with strong, close punctures, which sometimes leave a narrow impunctate line in middle. Frons dullish, densely punctured, and obscurely striate. Mesoscutum and scutellum polished, with fine, almost dense punctures, becoming sparser on scutellum and posterior middle of scutum. Mesopleura shining, but roughened by fine, shallow, close punctures. Basal area rather small, tessellate, and finely rugulose at base. Rest of propodeum like the mesopleura, except that the sides are polished, with scattered punctures and erect hairs on anterior halves. Abdomen polished, with minute, moderately close punctures, which become sparse on disk of tergite 1. Middle basitarsi distinctly broader than the hind pair. Stigma about one-half as wide as marginal cell. Second submarginal cell quadrate, receiving the recurrent nervure a little before or behind the middle. Length 8.5–12 mm.; anterior wing 7–8 mm.

*Male*.—Similar to female in color, pubescence, and sculpture. Clypeus, except two dark dots, and lateral face marks more or less filling space between clypeus and eyes, yellow. Hair of mesonotum not much shorter than that of mesopleura. Tergites 1 to 5 each with an apical hair band, the disk of each in front of band with fairly long, erect light hair. Venter very hairy, with erect hair on disk of segments and a dense apical fringe on segments 2 to 5. Process of labrum deeply emarginate, the tooth on each side triangular and acute. Clypeus shining, with fine, moderately close punctures. Third antennal joint barely longer than the next two together. Legs rather robust, the hind tibiae with rather long, loose hair that is somewhat plumose. Apical margin of sixth ventrite strongly reflexed and more or less ferruginous. Latero-apical lobes (parameres) of stipites rather elongate, with a semioval dilation, about four times as long as wide, straight on outer margin, arcuate within, and also with a narrow arcuate expansion on the inner surface of the short basal part. Sagittae subdepressed, broadly fusiform in basal part, then tapering to bluntly rounded apex beneath the slightly overlapping tips of the parameres. Fusiform part of sagittae convex above, and acutely margined on the sides. Length 7–9 mm.; anterior wing, 6.5–7.4 mm.

*Types*.—U.S.N.M. No. 59273. Holotype (female) and allotype, Riverside, Calif., at flowers of *Isocoma* (or *Aplopappus*) *veneta* var. *vernonioides*, October 13, 1929, and October 9, 1927.

Paratypes in the collection of the Citrus Experiment Station: 11 males, 28 females, Riverside, on same flower and on *Gutierrezia californica*, the males taken from September 27 to October 20, the females from October 9 to November 8, in different years; 2 males, 3 females, Morongo Valley, San Bernardino County, on *Gutierrezia lucida*, October 5, 1934, and September 26-27, 1944; 3 males, 18 females, Yucca Valley, on same flower, September 28 and 30, 1944; 2 males, 5 females, at summit of ridge (on highway) dividing Morongo and Yucca Valleys, on same flower, September 28, 1944 (all Timberlake); in the collection of the University of California: 1 female, Fort Tejon, October 20, 1938 (F. T. Scott); 5 males, San Diego, August 25, 1927 (J. C. von Boeker); 2 males, 9 females, Antioch, Contra Costa County, on unidentified Compositae, September 8, 1948 (P. D. Hurd and J. W. MacSwain); 1 male, 1 female, same locality, on *Gutierrezia*, September 13, 1936; and 1 female, Naples, Santa Barbara County, August 15, 1935 (E. G. Linsley).

ANDRENA (PTERANDRENA) TREVORIS Cockerell

*Andrena trevoris* COCKERELL, Entomologist, vol. 30, p. 306 (male), 1897.

This species was described from Olympia, Wash. I have a male from Corvallis, Oreg. (Scullen), taken, as was the type, on June 12, although 30 years later. Cockerell compared his species with *A. bipunctata* Cresson (*flavoclypeata* Smith), and the males of the two species are indeed very similar, although belonging to different groups. The female, which I believe belongs here, is new. It is remarkable for having the hypostomal carinae extremely high, and nothing even approaching this condition has been seen in any other species. The carinae are present also in the male but are not so high.

*Male*.—Black, the clypeus yellow, with exception of the anterior margin and two dots on the disk. Tarsi ferruginous, the flagellum dark ferruginous beneath. Cheeks very broad and rounded behind. Antennae rather long, with joint 3 distinctly longer than the following joint, but shorter than 4 and 5. Wings reddish smoky, the stigma and nervures ferruginous. Clypeus shining, minutely and closely punctured. Frons finely striato-rugulose. Mesoscutum finely and strongly punctured, the surface tessellate, rather shining, and becoming almost polished on the posterior middle and scutellum. Abdomen shining, with minute, close, setigerous punctures. Pubescence pale ochreous or grayish, moderately sparse on head and thorax, and short and suberect on the abdomen, becoming depressed on apical margin of the tergites to form narrow, fringelike apical bands on segments 2 to 5. Length 8 mm.; anterior wing 6.5 mm.

*Female*.—Black, the flagellum beneath, and usually the legs, nearly uniformly reddened. Wings as in the male. Head as broad as long, the hypostomal carinae very high and even. Clypeus large, strongly projecting, the apical margin flaring and prominent. Facial foveae rather narrow, a little wider than half the distance between eye and lateral ocellus and extending slightly below antennae. Antennal joint 3 barely longer than joints 4 plus 5. Process of labrum much broader than long, the sides sloping, the apex foveato-emarginate. Clypeus tessellate, a little dullish, and rather closely punctured. Frons beneath the foveae closely and finely striate. Mesoscutum shining, closely and finely punctured and tessellate on the anterior part, its posterior middle and the scutellum polished and more sparsely punctured than the remainder of mesoscutum. Propodeum dull and finely rugulose, the enclosure similarly sculptured. Abdomen almost polished and provided with minute, close, setigerous punctures. Pubescence ochreous or fulvo-ochreous, moderately dense on the thorax. Apical hair bands present on tergites 2 to 4, covering the apical depressions and more or less interrupted on middle of tergite 2. Tergite 1 with similar hair on each side of apical margin. Disk of tergites 2 to 4 with extremely short, fine, appressed dusky hair in front of the bands. Apical fimbria usually more tawny or more fulvous than pubescence of body. Hair of legs concolorous with body, the apical tuft of hind femora pale chocolate color, and hair next to the knee plate more or less blackened. Scopal hair of hind tibiae moderately, but rather obscurely, plumose. Length, about 10 mm.; anterior wing, 7.5 mm.

*Collecting records*.—One male, Corvallis, Oreg., June 12, 1925 (Scullen); 2 females, Corvallis, collecting pollen from wild rose, June 9, 1909 (Bridwell); 2 females, Corvallis, June 19, 1921 (collector unknown); 1 female, Union, Oreg., 2,716 feet, June 11, 1926 (Scullen).

Two females from Tahquitz Valley, San Jacinto Mountains, Riverside County, Calif., July 17 and 23, 1912 (Bridwell), seem to be the same species but have the clypeus more sparsely punctured, the pubescence uniformly dull fulvous, and hind tarsi and small joint of the other tarsi clear ferruginous. The pollen collected by these females appears to be identical with that carried by the females, from Corvallis, taken on wild rose.

ANDRENA (PTILANDRENA) LAYIAE, new species

This differs from other similar species with a metallic color in having the green color confined to the abdomen. The tibial scopa is moderately plumose.



*Female*.—Black, with tergum of abdomen dark blue-green. Mandibles slightly reddened at apex. Flagellum slightly brownish beneath. Tarsi more or less reddened, the claws ferruginous. Tibial spurs pale testaceous, or rufotestaceous. Tegulae piceous, becoming redder at apex. Wings strongly and uniformly dusky, the stigma and nervures dark ferruginous. Head much broader than long, with the malar space nearly obsolete. Facial foveae rather narrow, extending slightly below antennae, covering about half the space between eye and lateral ocellus, and separated throughout from eye by a shining, minutely punctate space that is about one-third as wide as the fovea itself. Mandibles nearly normal, the explanate expansion on lower margin short and narrow. Labrum rounded at apex, the basal process about as long as width of its apical truncation, the sides diverging toward base. (In the Walnut Creek specimens the process is rounded at apex.) Antennal joint 3 about as long as joints 4 to 6 combined. Middle basitarsi moderately dilated and a little wider than the hind basitarsi. Basal nervure meeting the nervulus, the stigma moderately narrow. Second submarginal cell a little less than half as long as the third and receiving the recurrent nervure at or a little beyond the middle. Head and thorax granular-tessellate and dull. Clypeus with fine, very close punctures, the frons strongly striate. Mesoscutum with close, minute sharp punctures. Basal area of propodeum small, with more or less radiating rugae at the base. Pleura of propodeum delicately tessellate and shining. Abdomen finely tessellate, rather shining, and with minute, rather close punctures. Pubescence reddish fulvous, or ochreous, paler on the face and beneath, and moderately dense on face and thorax. A little black hair present at apex of scapes and on vertex behind summit of eyes. Facial foveae dark seal brown, becoming ochreous below in holotype when viewed from above. Floccus of propodeum long and but little curled, the pleuron below the floccus with a few scattered erect hairs. Abdomen sericeous with fine, appressed light pubescence, becoming denser at the sides of tergites 2 to 4, but not forming hair bands. Tergite 1 with short, erect hair on lateral margins, its disk and disk of tergite 2, except apical part, nude. Apical fimbria pale fulvous brown. Hair of legs pale ochreous, tinged with brown on outer side of front and middle tibiae, on front tarsi, at apex of hind femora, and on dorsal margin at base of hind tibiae. Flocculus of hind trochanters long and rather thin. Scopa of hind tibiae moderately compact, the hairs on dorsal margin plumose and about two-thirds as long as greatest width of tibia, and the hairs of remainder of scopa rather weakly plumose. Length 10–12.5 mm.; anterior wing 8–9.2 mm.



*Types*.—Holotype (female), Ensenada, Baja California, Mexico, at flowers of *Layia*, April 24, 1941 (Cockerell) and one paratype (female) 10 miles north of Salis, Calif., on *Layia glandulosa*, May 18, 1936 (E. G. Linsley), in the collection of the Citrus Experiment Station.

Two paratypes (females) with same data as above paratype, in the collection of the University of California at Berkeley. Three paratypes (females), Walnut Creek, Contra Costa County, April 19, 1913 (J. C. Bridwell), in the U. S. National Museum, U.S.N.M. No. 59274.

ANDRENA (STENANDRENA) PALLIDIFOVEA (Viereck)

*Pterandrena pallidifovea* VIERECK, Can. Ent., vol. 36, pp. 222, 228, 1904 (female; excluding male, p. 195).

*Andrena plumifera* COCKERELL, Can. Ent., vol. 48, p. 393, 1916 (female).

This is a common species on the Pacific coast, extending from southern California to Washington, and inland to Salt Lake City, Utah. It is a late vernal species and collects pollen from Compositae. In southern California it collects pollen from *Ericameria cooperi*, *Helianthus gracilentus*, and from species of *Layia*, *Eriophyllum*, and *Chaenactis*.

In the United States National Museum it is represented by specimens from Pasadena, Calif., April 30, 1909; Arroyo Seco, Pasadena, June 17, 1909; and near Pasadena, 1,200 feet, April 15, 1911 (F. Grinnell, Jr.).

The male, associated with *pallidifovea* by Viereck, presumably had light face marks, as it was included in the table of males of *Opandrena* and *Pterandrena*. The true male of *pallidifovea* has the face entirely dark and may be briefly characterized as follows:

*Male*.—Dull black. Flagellum a little shining beyond the first joint, brownish beneath. Antennal joints 3 to 5 subequal, 4 being slightly shorter than the others and 3 slightly longer. Face and mesonotum opaque, the clypeus roughened by close, shallow punctures, the mesonotum impunctate. Vertex substriate between ocelli and eyes. Abdomen dullish, with extremely fine, dense setigerous punctures. Pubescence ochreous to fulvo-ochreous, lighter on the vertex and mesonotum. Hair of head and thorax long, erect, rather dense on face below antennae and on cheeks. First tergite and sides of the second with moderately long, erect light hair. Tergites 2 to 4 rather narrowly fasciate at apex with whitish hair, the band on 2 interrupted medially. The light hair at apex of tergite 5 longer and thinner than that forming the bands of preceding segments. Disk of tergites 2 to 5 densely covered with fine, very short, subdepressed hair, which is blackish except at base of tergite 2. Apical fimbria a little tinged with brown. Legs

slender, with hair entirely light and the tarsi very long. Length 8-12 mm.

ANDRENA (STENANDRENA) ESSIGI, new species

Similar to *A. pallidifovea* (Viereck), but smaller, the abdomen duller and with distinct but minute dense punctures on the basal segments.

*Female*.—Black, the mandibles usually dark red on apical half, the flagellum strongly reddened beneath except at base. Small joints of tarsi more or less ferruginous. Tegulae ferruginous, darker at base. Wings uniformly dusky hyaline, the nervures and stigma dark ferruginous, with subcosta and margins of stigma darker. Head distinctly broader than long. Facial foveae rather broad, not much narrowed below, where they reach the level of top of clypeus, and covering above hardly more than half the space between eye and lateral ocellus. Labrum broadly rounded in front, the basal process more than twice as broad as long, with sloping sides and broadly truncate apex. Middle basitarsi slightly broader than the hind pair. Head and thorax dull, minutely granular-tessellate. Clypeus and anterior sides of face with small, shallow, moderately close punctures, becoming a little coarser on middle of clypeus. Frons rugulose, obscurely striate. Mesoscutum opaque, obscurely punctured. Pleura of thorax more shining than the notum, a little roughened on anterior part of each mesopleuron. Pleuron of propodeum delicately tessellate and shining, without punctures or hairs except along the anterior margin. Dorsum of propodeum dull, rugulose roughened, the sculpture of basal area still rougher, with fine rugae. Abdomen dullish, minutely and very closely punctate, the punctures more distinct on the two basal tergites and a little sparser on the first than on the second. Pygidial plate planate, dull, densely and minutely punctured except at apex. Pubescence ochreous, moderately dense on face and thorax, becoming more or less fulvo-ochreous on vertex and notum of thorax. Mesoscutum with rather dense, short, erect hair, interspersed with numerous longer, erect hairs. Hair at apex of hind femora, apex of middle tibiae, and at base of hind tibiae above, brown. Tergites 2 to 4 each with a dense, apical, pale-ochreous or whitish hair band, usually broadly interrupted on 2. Extreme sides of apical margin of first tergite with similar appressed hair. Base and lateral margins of first tergite with erect, not very long, pale hair. The disks of tergites 1 and 2 otherwise nude, but disks of tergites 3 and 4 and base of tergite 5 with very short appressed black hair. Apical fimbria brown but long hairs at sides of tergite 5 and at base of the fimbria more or less pallid. Length 7.5-10 mm.; anterior wing 6.3-7.1 mm.

*Male*.—Similar to the female and difficult to distinguish from the male of *A. pallidifovea*. Differs from the latter in smaller average size and in the very narrow hair bands of the abdomen, interrupted on tergite 2 and usually also on tergite 3. The subdepressed hair on disk of tergite 2 mainly light, but that on disk of tergites 3 to 5 black. The genitalia of the two species virtually identical. Length 6.5–9 mm.; anterior wing 5.5–7 mm.

*Types*.—Holotype (female), allotype, and 51 paratypes, from The Gavilan, Riverside County, Calif., April 1 to 30, 1 on *Layia elegans*, the rest on *Baeria*; 4 males, 1 female, Riverside, on *Baeria*, except 2 of the males taken on *Cryptantha* and *Sisymbrium*, respectively, March 3 to April 6; 1 female, Railroad Canyon, near Elsinore, on *Baeria*, April 7 (Timberlake); and 2 females, Claremont (E. O. Essig), in the collection of the Citrus Experiment Station. The holotype and allotype were taken on *Baeria*, April 10, 1940.

Paratype, 1 female, 1 male, Mount Hamilton Range, Santa Clara County, Calif., April 26, 1913 (J. C. Bridwell), in the United States National Museum, U.S.N.M. No. 59275.

This species is dedicated to Prof. E. O. Essig, who collected specimens at Claremont, presumably while a student at Pomona College.

ANDRENA (STENANDRENA) VEXABILIS, new species

Similar to *A. pallidifovea* (Viereck), but the female distinguishable by having the abdomen virtually impunctate, and the male by having antennal joint 4 hardly longer than thick and distinctly shorter than joint 3.

*Female*.—Black, the apical joints of tarsi more or less ferruginous. Flagellum only slightly reddened beneath. Tegulae dark. Wings uniformly dusky hyaline, the stigma dark red, the nervures more ferruginous, except subcosta and margins of stigma, which are blackish. Structural characters and sculpture mostly as in *pallidifovea* and *essigi*. Clypeus opaque, generally with the punctures very obscure, sometimes with a very fine transverse striation on the upper half of disk. Basal area of propodeum dull, finely granular-tessellate, the sculpture finer than that of remainder of dorsal surface of propodeum. (In *pallidifovea* the sculpture of basal area usually distinctly coarser than that of remainder of dorsal surface.) Abdomen minutely tessellate, moderately shining, virtually impunctate, although very minute, mostly remote punctures become discernible on close inspection. (In *pallidifovea* the tergites have a close, very minute puncturation, which in *essigi* becomes much more obvious.) Process of labrum a little larger



than in *pallidifovea*, much broader than long, broadly rounded or truncate at apex, or sometimes slightly emarginate at the middle of the apex. Pubescence much as in *pallidifovea*, varying from ochreous to fulvous on vertex and notum of thorax. Hair of mesoscutum long, erect, without short hair. (In *pallidifovea* hair of mesoscutum rather short and interspersed with longer hairs.) Usually some inconspicuous blackish hairs present on vertex, especially behind the summit of eyes. Facial foveae darker than in *pallidifovea*, seal brown above and whitish or ochreous at lower end. Tergites 2 to 4 each with a broad, dense apical hair band, interrupted medially on tergite 2. Disk of tergites 1 and 2 nude, that of 3 and 4, and base of tergite 5, with very short, subappressed black hair. Apical fimbria brown. Length 9–12 mm.; anterior wing 7.5–8 mm.

*Male*.—Very similar to the male of *A. pallidifovea*, but antennal joint 3 distinctly longer than 4 and slightly longer than 5, joint 4 being barely longer than thick. Pubescence pale ochreous to whitish, with some long black hairs on sides of face and behind summit of eyes. Hair bands on tergites 2 to 5 weak, those on segments 2 and 3 broadly interrupted at the middle. Genitalia virtually the same as in *pallidifovea*. Length 7.5–10 mm.; anterior wing 7 mm.

*Types*.—U.S.N.M. No. 59276. Holotype (female), allotype, and 14 paratypes (7 males, 7 females), San Francisco, Calif., April 13, 1913; 8 females (paratypes), San Geronimo, Marin County, April 23, 1913; 11 females (paratypes), Mount Hamilton Range, Santa Clara County, April 26, 1913 (J. C. Bridwell).

*Other records*.—Four females Russelman Park, Contra Costa County, on *Baeria*, April 26, 1942 (E. G. Linsley); 1 female, Kern County, April 1939 (F. T. Scott); and 1 female, Mendocino County (E. R. Leach), in the collection of the Citrus Experiment Station.

ANDRENA (HESPERANDRENA) ESCONDIDA Cockerell

*Andrena escondida* COCKERELL, Ann. Mag. Nat. Hist., ser. 11, vol. 2, p. 146, 1938 (male).

This was described from Santa Catalina Island. The female has been recorded by Cockerell but not described. For purpose of comparison with the following new species, it is now briefly characterized as follows:

*Female*.—Black, without any distinct metallic tinge. Head and thorax dull, the lower part of mesopleura, metapleura, and pleura of propodeum more shining. Clypeus with sparse, minute, indistinct punctures. Frons striate. Mesonotum tessellate, becoming more shiny on posterior middle of the scutum and base of scutellum, and finely, strongly, and closely punctured. Basal area



broadly triangular, sculptured almost like remainder of dorsal surface of propodeum, although minutely striate on basal margin. Abdomen strongly tessellate, dullish, and minutely punctate, the punctures sparse on tergite 1 and rather close on 2. Process of labrum low and broadly truncate at apex. Facial foveae extremely broad, each about as broad above as the space between them, ochreous in color, becoming slightly brownish above. Pubescence of head and thorax brownish ochreous, moderately sparse. Tergites 2 to 4 of abdomen each with a distinct whitish apical fascia, that on 2 broadly interrupted at the middle. Apical fimbria pale brown. Tibial scopa moderately loose and long, the hairs on dorsal margin a little longer than width of tibia. Wings dusky hyaline, with dark-ferruginous stigma and nervures. Length about 9 mm.; anterior wing 7 mm. (or about 6.6 in the Ensenada female).

The female is now known from Rancho Santa Ana, Orange County, Calif., and Ensenada, Baja California, having been taken in both places at flowers of *Layia*.

ANDRENA (HESPERANDRENA) LIMNANTHIS, new species

Like *A. escondida* Cockerell, but more opaque black, almost without puncturation, the facial foveae brown, moderately broad, and the abdomen hardly fasciate.

*Female*.—Black, the mandibles a little reddish at apex. Flagellum dark. Legs black, although sometimes tinged with red. Tegulae piceous, more reddish at apex. Wings dusky hyaline, the stigma and nervures dark reddish, the subcosta blackish. Head and thorax opaque, becoming less dull on lower sides of thorax, the pleura of propodeum shining. Clypeus and mesonotum, especially the anterior part of scutum, with very fine faint punctures. Frons striate. Enclosure of propodeum large, forming nearly a right angle, tessellate, becoming a little duller at base. Abdomen tessellate, slightly shiny, virtually impunctate. Process of labrum triangular, rounded to subacute at apex. Facial foveae moderately broad, reaching level of top of clypeus. Antennal joint 3 slightly longer than the next two joints together. Pubescence rather scanty, pale ochreous, becoming pale brownish fuscous on face and vertex. Hair of mesoscutum rather short and erect, with finer and shorter hairs interspersed. Abdomen with fine, short, appressed light pubescence, becoming slightly denser and longer at apex of tergites 3 and 4 and at sides of the apex of tergite 2, but forming very narrow, indistinct hair bands. Tergite 1 with short, erect hair, especially laterally. Apical fimbria brown. Hair of legs pale, becoming somewhat brownish on outer side of front

and middle tibiae. The dense tuft of hair at apex of hind femora, above, brownish fuscous. Tibial scopa pale brown above, more whitish beneath, moderately short and compact, with the hair on dorsal margin about half as long as width of tibia. Second submarginal cell usually considerably narrowed above and receiving recurrent nervure at, or a little behind, the middle. Third submarginal cell rather short and less than twice as long as the second. Basal nervure slightly postfurcal. Length 8–10 mm.; anterior wing 6.8–7 mm.

*Male*.—Similar to the female in most respects. Face without a light clypeal mark. Apex of mandibles dark red. Flagellum dull, slightly brownish beneath. The little ridge marking the base of apical depression of tergites 2 and 3 reddish on each side, forming a transverse streak. Apical margin of tergites very narrowly smooth and shiny. Basal process of labrum rounded at apex, and finely foveate beneath at the middle. Antennae short, only moderately longer than in the female. Antennal joint 3 equaling 4 plus 5. Pubescence whitish to pale ochreous, longer than in the female, especially on the thorax. Hair of face and clypeus moderately dense. Hair of abdomen rather short, depressed, and thin, not at all forming bands; that of tergite 1 much longer and erect. Hair of venter similar to that of tergum, with longer, erect hair on each side of the subapical segments. Medio-apical lobes of stipites virtually obsolete, making the dorso-apical margin almost transverse. Latero-apical lobes of stipites elongate, as usual in this group, slightly angulate on inner margin before the middle and convergent at their tips. Sagittae as in other species of this group, the apex slightly surpassing apex of the stipital lobes. Length 6.5–8 mm.; anterior wing 5.8–6.2 mm.

*Types*.—U.S.N.M. No. 59277. Holotype (female), allotype, and 37 paratypes (8 males, 29 females), San Geronimo, Marin County, Calif., April 23, 1913 (J. C. Bridwell).

Paratypes, 2 males, 7 females, Santa Rosa, Sonoma County, on *Limnanthes douglasii*, April 17, 1938 (Embury), and 1 male, Agua Caliente, Sonoma County, on same flower, April 14, 1938 (Frazier), in the collection of the Citrus Experiment Station.

ANDRENA (HESPERANDRENA) LATIVENTRIS, new species

The female of *lativentris* differs from other species of *Hesperandrena*, except *A. limnanthis*, in having the mesoscutum black, dull, and strongly tessellate, with the punctures obscure. From *limnanthis* it differs in the less opaque sculpture; longer, less compact, more plumose tibial scopa; and in having the abdomen more definitely fasciate. The male differs from *limnanthis* in having the clypeus mainly pale yellow.

*Female*.—Black, the mandibles strongly reddened except on the basal third. Flagellum brownish beneath. Small joints of tarsi ferruginous, the basitarsi more dusky. Tegulae reddened at apex. Wings as in *limnanthis* as to color and neuration, except that the second submarginal cell is less narrowed above. Apical margin of tergites, especially of the second, subhyaline and then reddened. Head and thorax very finely tessellate, dullish, although a little shining in some aspects. Clypeus subopaque, impunctate. Frons finely striate. Mesoscutum with fine, close, but indistinct punctures. Enclosure of propodeum and abdomen nearly as in *limnanthis*. Process of labrum small, very short, a little emarginato-truncate on middle of apex. Facial foveae whitish, broad above, each covering slightly more than one-fourth of space between the eyes. Antennal joint 3 about equaling the next three joints together. Pubescence whitish to pale ochreous, most conspicuous on the face and cheeks, the hair of clypeus subdepressed and partially concealing the surface. Hair of mesonotum short and erect, becoming longer on anterior part of scutum and on apical margin of scutellum. Pubescence of abdomen fine and appressed, forming white apical hair bands on tergites 2 to 4, these bands being broadly interrupted on tergites 2 and 3. Apical fimbria tinged with brown. Hair of legs mostly whitish, but brownish on outer side of middle tibiae at apex, with tuft at apex of hind femora, and the tips of scopal hairs on dorsal side of hind tibiae, brown. Scopa of hind tibiae rather long and moderately dense, the hairs on dorsal margin obviously plumose and slightly longer than greatest width of tibia, the hairs on the outer surface obscurely plumose. Labial palpi short, the basal joint strongly bowed; the two middle joints short, thickened, and oblique, hardly longer than wide; the apical joint slender and nearly twice as long as preceding joint. Length 7-9 mm.; anterior wing 6-6.6 mm.

*Male*.—Similar to female. Clypeus, except outer corners and narrow apical margin, pale yellow. Tergites narrowly reddened contiguously to the subhyaline apical margins, these reddened areas on tergites 2 and 3 definitely much widened on each side to form more or less conspicuous spots. Process of labrum small, more thickened and more prominent than in female, rounded and arched apically, and, at most, weakly foveate medially below the margin. Antennae short, with joint 3 equaling 4 plus 5, which are quadrate. Pubescence white, much longer than in female, with the hair of face and cheeks rather dense and almost concealing the yellow clypeal mark. Hair of mesonotum long and thin, that of first tergite similar, and that of following segments short and appressed, forming weak apical hair bands on tergites 3 to 5.



Sternites 2 to 5 each with a strong apical fringe. Medio-apical lobes of stipites slightly produced. The latero-apical lobes bowed inward, so that they are nearly opposed to each other on their apical halves, and not angulate on inner margin. Sagittae nearly as in *limnanthis*. Length 6.5–9 mm.; anterior wing 6–6.5 mm.

*Types*.—U.S.N.M. No. 59278. Holotype (female) and allotype, near Strathmore, Tulare County, Calif., on *Baeria tenella*, March 29, 1937. Paratypes, 2 females, Mount Hamilton Range, Santa Clara County, April 26, 1913 (J. C. Bridwell); 1 male, Elsinore, Riverside County (Baker).

Paratypes, in the collection of the University of California at Riverside and Berkeley: 32 males, 9 females, from Strathmore, March 28–29, 1937, and April 1, 1933 (Timberlake); 51 males, 24 females, Earlimart, Tulare County, on *Baeria tenella*, March 9, 1937 (Timberlake and Linsley); 1 female, Earlimart, on *Baeria gracilis*, March 30, 1937 (Timberlake); 3 females, Kern County, April 1939 (F. T. Scott); 2 males, 2 females, Davis, May 12, 1937 (J. J. DuBois); 4 females, Russelman Park, Contra Costa County, on *Baeria*, April 26, 1942 (E. G. Linsley); 73 females, near Hemet Lake, San Jacinto Mountains, Riverside County, on *Layia platyglossa*, May 24, 1939 (Linsley); 1 female, Herkey Creek, San Jacinto Mountains, on *Layia platyglossa*, June 3, 1939 (Timberlake).

*Other records*.—A series from Hemet Lake is in the collection of the U. S. National Museum.

ANDRENA (HESPERANDRENA) DUBOISI, new species

This species is allied to *A. baeriae* Timberlake, but it differs from that and other species of the group in having the integument much more definitely tinged with green. The male differs from *baeriae* also in having a large pale-yellow mark on the clypeus.

*Female*.—Integument tinged with dark green, which is more pronounced on abdomen than on head or thorax. Mandibles dark red at apex. Antennae black, the flagellum brownish beneath. Legs black, or more or less reddish brown, with the tarsi more rufescent. Tegulae shining rufopiceous, redder at apex. Wings a little dusky fulvescent, the stigma and nervures pale ferruginous; the subcosta blackish. Facial foveae moderately broad, extending below level of antennae, and pale brownish ochreous as seen from above. Subgenal coronet dark red. Explanate expansion of outer margin of mandible narrow, ferruginous, and extending beyond the middle. Antennal joint 3 barely longer than the next two joints together. Head and thorax minutely



tessellate, moderately dull. Frons distinctly striate. Clypeus, sides of face below antennae, and mesoscutum with fine, shallow, moderately close punctures. Scutellum impunctate. Upper part of mesopleuron subopaque. Basal area broadly triangular, its sculpture minute and a little less rough than that of remainder of dorsal surface of propodeum. Abdomen minutely tessellate, rather shining and impunctate. Pubescence ochreous, rather short and moderately sparse, being densest on the face and cheeks. Abdomen with fine, short, appressed light pubescence, very thin on middle of disk of tergite 2, and becoming longer and denser at apex of tergites 2 to 4 to form bands. Band on tergite 2 thinner or interrupted at the middle. Apical fimbria, hair at apex of hind femora, at apex of middle tibiae, and at base of hind tibiae on dorsal margin, slightly tinged with brown. Basal nervure distinctly postfurcal. Second submarginal cell about half as long as the third, and receiving the recurrent nervure at or near middle. Length 5.5–8 mm.; anterior wing 5–6.1 mm.

Females from along the coast of California (Walnut Creek, San Francisco, and San Diego) have the facial foveae more pallid than in the type series from Davis, and have the apical depression of tergites rufotestaceous to whitish.

*Male*.—Similar to female. Disk of clypeus pale yellow. Pubescence paler and longer than in female, dense and white on face, and nearly concealing the surface of clypeus. Hair of mesoscutum long and erect. Apical bands of abdomen thin or, usually, obsolete. Disk of tergite 1 with long, erect hair. Hair of venter rather long and erect, the apical margin of segments 2 to 5 each with a very short apical fringe. Antennae barely longer than in the female, the flagellum stout. Joint 3 about equaling 4 plus 5, which are both broader than long. Process of labrum about twice as broad as long and more prominent than in female. Medio-apical lobes of stipites together forming a subacute angle. Latero-apical lobes of stipites geniculate before the middle, strongly bent downward, and pallid at apex. Apical part of sagittae very slender and becoming slightly expanded at the extreme apex. Length 5–7.5 mm.; anterior wing 4.5–6 mm.

*Types*.—U.S.N.M. 59279. Holotype (female) and allotype, Davis, Calif., presumably at flowers of *Baeria*, May 12, 1937 (J. J. DuBois); 3 females (paratypes), Walnut Creek, Contra Costa County, April 17, 1913 (J. C. Bridwell); 1 female (paratype), San Francisco (Bridwell); and 1 female (paratype), San Diego.

Many paratypes (82 males, 108 females) from Davis in the collections of the Citrus Experiment Station and of the University of California at Berkeley.

## ANDRENA (MICRANDRENA) PIPERI Viereck

*Andrena piperi* VIERECK, Can. Ent., vol. 36, pp. 189, 196 (female), 1904.

The type locality is Pullman, Wash., but the species ranges to southern California. It is a common winter and spring bee at Riverside, and the female collects pollen from Cruciferae, especially from *Alyssum*, *Brassica*, *Capsella*, and *Sisymbrium*. I have one female collected at Salt Lake City, Utah, May 4, 1913; a male from Riparia, Wash., April 8, 1908 (Aldrich); a male from Merrill, Oreg., from wild mustard, May 10, 1929 (C. C. Wilson); besides many from Riverside.

In the U. S. National Museum is the following material: 1 female, Mount Hamilton Range, Santa Clara County, Calif., April 26, 1913 (J. C. Bridwell); 1 female, Berkeley, April 19, 1915 (E. P. Van Duzee); 2 males, Sacramento, March 6, 1931 (C. C. Wilson); 8 males, Stanford University, March 4-24, 1910; 4 males, Stanford University, March 21 and 24, 1915 (H. Morrison); 2 males, 3 females, Redlands (F. R. Cole); and 1 male, Claremont (Baker).

The male has not been described, and in the National Museum material two manuscript names were attached to specimens of this sex by Viereck. It may be distinguished from males of other North American species of this group by means of the following characters: Integument black, with a slight aeneous tinge; the clypeus yellow, with two minute black dots. Wings faintly dusky, with ferruginous stigma and nervures. First abscissa of radius more or less short or punctiform. Antennae moderately long, with joint 3 longer than 4, but distinctly shorter than 4 plus 5. Head and thorax dull, granular-tessellate. Enclosure very large, finely granular-rugulose, the sculpture somewhat coarser than that of remainder of propodeum. Pubescence usually white, and very long and copious on the cheeks, sides of thorax, and on the front femora.

## ANDRENA (MICRANDRENA) CHLOROGASTER Viereck

*Andrena chlorogaster* VIERECK, Can. Ent., vol. 36, pp. 189, 196 (female), 1904.

From Oregon and California there are now known three very similar species of *Micrandrena*, which are distinguishable with difficulty in the female, but which are surely distinct by the characters of the male, especially those of the genitalia (cf. key, page 396). With only a few specimens at hand from Oregon, it is impossible to be sure about the correct usage of the name *chlorogaster*, but I have provisionally assigned the name to a species which ranges from Corvallis, Oreg., southward to Riverside County and Santa Catalina Island, Calif. *A. chlorogaster*

was described from Oregon, without a more definite locality. The male is new.

*Male*.—Integument with a very dark-green or bluish green luster. Clypeus pale yellow except on the margin, and without dark dots. Flagellum dark reddish ferruginous, blackish above. Small joints of tarsi ferruginous. Tegulae dark testaceous brown. Wings rather dusky hyaline, the stigma and nervures reddish brown. Frons and vertex finely granular-striate. Face below antennae dullish, finely shagreened and indistinctly punctured, the clypeus a little more shining and minutely tessellate. Mesoscutum, scutellum, and metanotum finely tessellate and dullish, the scutellum a little more shining than the other parts. Basal area very large, finely rugulose, smoother toward apex, the sculpture coarser than that of remainder of propodeum. Abdomen minutely tessellate, a little dullish and impunctate. Antennae long, with the middle joints of flagellum distinctly longer than thick, and joint 3 shorter than 4. First abscissa of radius very short or punctiform. Pubescence whitish, moderately long and dense on cheeks and pleura. Usually with much black hair present on sides of face and behind summit of eyes. Genitalia short and compact. Parameres of stipites very stout, the expanded apical part semi-oval, about twice as long as wide, with the inner margin evenly and convexly arcuate from base to apex of the expansion. Sagittae dilated and bulbous at base, the apical part half compressed, with very thick, blunt, spreading tips, the dorsal crest of each component, just beyond the bulbous portion, much thickened and protuberant. Length 5–7 mm.; anterior wing 4.3–4.8 mm.

*Female*.—Like the male, but greenish luster perhaps a little less evident and most distinct on the abdomen. Sculpture as in male, with the clypeus dull, minutely granular-tessellate and obscurely punctate. Process of labrum quadrate, about as long as wide, truncate at apex, and a little widened toward the base. Facial foveae narrow, reaching a little below level of antennae, and usually a light fulvous brown. Pubescence whitish, tinged with brownish ochreous on vertex and notum of thorax. Apical fimbria brown. Tergites 2 to 4 each with a white apical fringe, broadly interrupted on 2 and 3. Length about 7 mm.; anterior wing 4.8–5.2 mm.

In the U. S. National Museum collection: 5 males, 1 female, Corvallis, Oreg., April 24, 1919 (I. N. Gabrielson); 1 male, 1 female, Mount Tamalpais, Marin County, Calif., March 30, 1913 (J. C. Bridwell); 2 males, Stanford University, March 18, 1912; and 1 male, Stanford University, March 17, 1917 (R. Stinchfield).



In the Riverside collection: 1 male, Putah Canyon, on boundary of Yolo and Solano Counties, Calif., on elderberry, February 29, 1936 (R. M. Bohart); 2 males, Berkeley, March 7, 1934, and March 26, 1935 (Bohart); 1 female, Berkeley, on *Ranunculus*, March 19, 1939 (E. G. Linsley); 2 males, 1 female, Visalia, March 29, 1939, and 1 female, on red clover, April 21 (F. T. Scott).

The material of *chlorogaster* from southern California is at least subspecifically distinct, and three races can be distinguished as based on the males.

#### KEY TO SUBSPECIES OF ANDRENA (MICRANDRENA) CHLOROGASTER

1. Flagellum dark reddish brown beneath; medio-apical lobes of stipites longer than wide and more or less pointed..... 2  
 Flagellum ferruginous beneath; medio-apical lobes of stipites blunt and no longer than their basal width; reflexed dorsal margins of sagittae, just beyond the basal expansion, arched as seen from side and nearly parallel with each other (Oregon and northern California).  
*chlorogaster chlorogaster* Viereck
2. Sides of face with only a trace of black hair; medio-apical lobes of stipites a little longer than wide; rounded expansion on inner margin of parameres near base longer than in *chlorogaster*; reflexed dorsal margins of sagittae, just beyond the basal expansion, about as in *chlorogaster* (Santa Catalina Island)..... *chlorogaster nesiotes*, new subspecies  
 Sides of face with considerable black hair; medio-apical lobes of stipites about twice as long as their basal width; expansion on inner margin of parameres near base as in *nesiotes*; reflexed dorsal margins of sagittae, just beyond the basal expansion, hardly arched and strongly divergent basad (San Diego and Riverside Counties).  
*chlorogaster gavilanica*, new subspecies

#### ANDRENA (MICRANDRENA) CHLOROGASTER NESIOTES, new subspecies

*Male*.—To the characters given above, it is necessary to add only that the antennae are somewhat shorter than in *chlorogaster*, with the joints of flagellum each about one and one-fourth times longer than thick. Length 5.5 mm.; anterior wing 4.7 mm.

*Type*.—One male (holotype), Santa Catalina Island, Calif., March 26, 1937 (Cockerell), in the collection of the Citrus Experiment Station.

#### ANDRENA (MICRANDRENA) CHLOROGASTER GAVILANICA, new subspecies

*Male*.—Almost exactly agreeing with *nesiotes*, except in regard to the characters noted in the above key. Length 5.75 mm.; anterior wing 4.7 mm.

*Female*.—Not distinguishable in any appreciable degree from typical *chlorogaster*. Length 6.5 mm.; anterior wing 4.5 mm.

*Types*.—Holotype (male), allotype, and 9 paratypes (females), The Gavilan, Riverside County, Calif., at flowers of *Lomatium dasycarpum* and *Sanicula bipinnatifida*, March 27 and April 10,



1946; and 2 females (paratypes), Camp Pendleton, 10 miles northeast of Oceanside, San Diego County, on *Sanicula bipinnatifida*, April 22, 1946 (Timberlake), in collection of the Citrus Experiment Station.

A small series of females from Pine Flat, near California Hot Springs, Tulare County, May 3, 1947 (Timberlake) seems to belong here. These females were taken at flowers of *Sanicula tuberosa*, except one that occurred at flowers of *Rhamnus crocea*.

ANDRENA (MICRANDRENA) RADIALIS, new species

Similar to *A. chlorogaster* Viereck, but the male has only a trace of black hair at sides of face, and the genitalia are distinctive. The female differs hardly at all, except that the foveae are whitish, and even this character may not always be distinctive.

*Male*.—Integument with a dark bluish-green tinge. Clypeus, except the margins, pale yellow, without black dots. Flagellum dark ferruginous beneath, blackish above. Wings slightly dusky, the nervures and stigma dark ferruginous. Antennae long, the middle joints of flagellum much longer than wide, and joint 3 shorter than 4. First abscissa of radius very short or punctiform. Basal area large and broad, finely granular rugulose, more coarsely so at base, where the sculpture is distinctly coarser than that of remainder of propodeum. Pubescence white and moderately long and dense on cheeks and pleura. Only a few dusky or blackish hairs on each side of face. Genitalia in general similar to those of *chlorogaster*, but parameres of stipites less thickened at base, and the apical expansion subtriangular. Compressed apical half of sagittae having the two component parts moderately incrassate at the tips, and the dorsal crest of each thin-edged and a little separated just beyond the basal bulbous portion. Length about 5 to 6 mm.; anterior wing 4.3–4.8 mm.

*Female*.—Like *chlorogaster*, but pubescence white, the facial foveae soiled whitish. Length 6–7 mm.; anterior wing 4.8–5 mm.

*Types*.—U.S.N.M. 59280. Holotype (male) and allotype, Elsinore, Riverside County, Calif. (Baker); another pair (paratypes), Redlands (F. R. Cole).

In the collection of the Citrus Experiment Station are the following paratypes: 107 males, 59 females, Riverside, taken on *Salix*, *Sisymbrium*, *Brassica*, *Capsella*, *Alyssum*, *Sedum* (in cultivation), *Taraxacum*, *Sonchus*, *Baccharis*, Marguerite daisy, and flying near *Sambucus*, February 16 to April 28; 2 females, Valyermo, Los Angeles County, on *Salix*, March 26; 1 female, Andreas Canyon, near Palm Springs, on *Sisymbrium*, March 2; 2 males, Soboba Hot Springs, on *Salix*, March 11; and 1 male,

San Jacinto River, at 2,100 feet, on *Salix*, February 22 (Timberlake).

The female collects pollen, as far as is known, only from *Salix*.

The following females, with no associated males, have whitish facial foveae as in *radialis*, but they may belong with *chlorogaster*, as the color of the foveae may not be always distinctive: 2 from The Dalles, Oreg., May 2 and 3, 1927 (Scullen); 1 from Marion, Oreg., May 13, 1928 (A. Gray); 1 from Salt Lake City, Utah, May 4, 1913 (Timberlake); 1 from Sand Flat, Calaveras County, Calif., 5,000 feet, June 11, 1930 (D. W. Clancy); and 1 from Berkeley, April 7, 1935 (R. M. Bohart). The two females from Visalia, recorded above under *chlorogaster*, also have whitish foveae, but are associated with males with definite *chlorogaster* characters.

ANDRENA (MICRANDRENA) NITIDICORNIS Cockerell

*Andrena nitidicornis* COCKERELL, Pan-Pacific Ent., vol. 12, p. 144, 1936 (male).

This is another sibling species difficult to distinguish, at least in the female sex, from *A. chlorogaster* and *A. radialis*. It was described from Garberville, Humboldt County, Calif., but I have taken it in southern California, in the foothills of the San Gabriel Mountains, up to an elevation of about 1,500 feet on *Ceanothus*, and also at The Gavilan, Riverside County, on *Salix*.

The male has much black hair on the face and behind the summits of eyes, and the yellow of the clypeus covers not much more than half of the disk. The parameres of the stipites are not angulate on the inner margin, the apical expanded part being elongate oval; and the bulbous basal part of the sagittae bears a distinct median impression apically.

These three sibling species are separated in the key, the characters given for the males having greater value:

KEY TO SPECIFIC CHARACTERS IN ANDRENA CHLOROGASTER,  
A. RADIALIS, AND A. NITIDICORNIS

- |   |              |
|---|--------------|
| 1. Females .....  | 2            |
| Males .....   | 4            |
| 2. Stigma and nervures ferruginous, facial foveae more or less pallid; scopal hairs of hind tibiae more distinctly curled.....        | 3            |
| Stigma and nervures reddish brown; facial foveae pale brown, more pallid below; scopal hairs more erect on outer face of hind tibiae. |              |
|   | chlorogaster |
| 3. Basal area of propodeum nearly uniformly finely granular; facial foveae whitish, tinged with brown above.....                      | radialis     |
| Basal area finely rugulose except on margins; facial foveae more brownish.  | nitidicornis |

4. Sagittae not so thick and blunt at apex and not spreading apart at their tips ..... 5  
Sagittae very broad and blunt at apex, their tips spreading apart.  
chlorogaster
5. Clypeus more or less broadly black on upper margin; sides of face with black hair; flagellum dark; dorsal margins of sagittae rather broadly reflexed just beyond basal bulbous part.....nitidicornis  
Clypeus narrowly black on upper margin; hair of face entirely, or almost entirely, whitish; flagellum ferruginous beneath; dorsal margins of sagittae not reflexed just beyond basal bulbous part.....radialis

# ANDRENA (MICRANDRENA) MICROCHLORA SUBALIA Cockerell

*Andrena microchlora subalia* COCKERELL, Pan-Pacific Ent., vol. 12, p. 143, 1936 (female; in part).

In the United States National Museum are 30 females, San Francisco, Calif., March 16, 1913 (J. C. Bridwell); 5 females, Mount Hamilton Range, Santa Clara County, April 26, 1913 (Bridwell); and 2 males, Berkeley, March 15, 1913 (Bridwell). In the Riverside collection is a female from Pullman, Wash., May 11, 1922 (Melander), and a pair from Corvallis, Oreg. (Scullen), the female taken April 26, 1928, and the male, on *Taraxacum*, April 17, 1929.

Cockerell described *subalia* from the coastal region of northern California, but confused two species in his material. The type and a cotype taken near Lower Lake, Lake County, at a yellow umbellifer are virtually indistinguishable from females of *microchlora* from Boulder, Colo. The remainder of the material, as far as I have examined it, is referable to *A. nitidicornis* Cockerell, and it is probable that Cockerell was led to separate *subalia* because of the inclusion of this extraneous material. The male of *microchlora* from Boulder, however, has the pubescence of the face entirely white, while the males from the Pacific coast have much black hair on the sides of the face and behind the summits of eyes. For this reason alone, the race *subalia* appears to deserve recognition.

The female of *microchlora* can be distinguished from the females of the *chlorogaster* group by the duller, more finely granular-tessellate and much more hairy mesoscutum, and by the upright, and but little curved scopal hairs of the hind tibiae.

# ANDRENA (MICRANDRENA) CANDIDIFORMIS SEMOTULA Cockerell

*Andrena semotula* COCKERELL, Pan-Pacific Ent., vol. 12, p. 149, 1936 (male).

This is only a weakly distinguishable race of *Andrena candidiformis* Viereck and Cockerell, the male having the stigma more or less infuscated and the flagellum black. It occurs in the mountains of southern California and northward along the coast to



Humboldt County. The type locality is 8 miles north of Ukiah, in Mendocino County. The female also may have the stigma darkened, but this character is slight and apparently unreliable, as three specimens collected in Mendocino County by E. R. Leach have the stigma as pale as in typical Colorado material. The female collects pollen from *Ceanothus*.

It is represented in the United States National Museum by 1 female from Walnut Creek, Contra Costa County, April 19, 1913 (J. C. Bridwell), and by 3 females from Santa Cruz Mountains, Santa Cruz County, April 25, 1913 (Bridwell).

ANDRENA (MICRANDRENA) MISERABILIS Cresson

*Andrena miserabilis* CRESSON, Trans. Amer. Ent. Soc., vol. 4, p. 259, 1872 (female).

*Andrena bipunctata* CRESSON, Trans. Amer. Ent. Soc., vol. 4, p. 259, 1872 (male).

*Andrena flavoclypeata* SMITH, Description of new species of Hymenoptera, p. 54, 1879 (male).

There is one male of this species in the United States National Museum from Sacramento, Calif., May 19, 1931 (C. C. Wilson). I have collected it also at a point 3 miles west of Three Rivers, Tulare County, but it is not known to occur in southern California.

ANDRENA (MICRANDRENA) HAROLDI, new species

This is most similar to *A. piperi* Viereck, from which it differs in its somewhat larger size and broader abdomen; in having the mesoscutum less opaque, it being tessellate instead of granular; and in having the abdomen devoid of the appressed light pubescence which is characteristic of *piperi*. This species was studied by Viereck, whose manuscript name I have adopted. Viereck associated males of *piperi* with the female of this species, and the true male appears to be one to which he had given another manuscript name.

*Female*.—Black, the abdomen with a faint, very dark-green tinge. Mandibles dark red at apex. Flagellum ferruginous red beneath except toward the base. Small joints of tarsi, especially the apical joint, pale ferruginous. Tibial spurs testaceous yellow. Tegulae piceous, becoming more or less brownish testaceous at apex. Wings dusky hyaline, with dull ferruginous stigma and nervures. Pubescence dull ochreous, moderately long, and thin enough to expose the integument. Apical fimbria of abdomen brownish fuscous. Tergites 2 to 4 each with a narrow, whitish apical hair band, interrupted medially on 2. Scopa of hind tibiae brownish on dorsal half, whitish below, rather long and moderately loose, the hairs on the outer surface entirely simple, and



those on dorsal margin fully as long as width of tibia. Facial foveae chocolate brown, or varying to reddish ochreous, when viewed from above, sometimes appearing entirely black in frontal view, moderately narrow, ending very bluntly at level of antennae, and somewhat narrowed and ill-defined above, where they cover about half the space between eye and lateral ocellus. Process of labrum with the sides very oblique and the apex rather narrow, rounded, or subtruncate. Head and thorax dull, without evident punctures. Clypeus almost opaque, impunctate, slightly roughened at apex. Frons substriate. Thorax minutely tessellate, subopaque in some views, more shiny in others. Basal area large, triangular, finely tessellate, the tessellation slightly coarser than that on remainder of dorsal surface of propodeum. Abdomen minutely tessellate, dullish, impunctate. Stigma moderately broad. First abscissa of radius a little less than half as long as the second. Second submarginal cell subquadrate, half as long as the third, and receiving the recurrent nervure at one-third of the length from the apex. Middle and hind basitarsi moderately narrow. Length 8 mm.; anterior wing 6 mm.

*Male*.—Resembling the female in many characters, but differing as follows: Clypeus yellow, except around the margins, with two black dots on disk, a little shiny on middle of disk, and rather obscurely and closely punctured on the yellow part. Process of labrum broad, only slightly elevated and truncato-emarginate at apex. Frons granular-tessellate, opaque, and not at all striate. Antennae longer than in female, the flagellum dark beneath, the joints of flagellum, including the first, about one and one-half longer than thick, and the apical one still longer. Thorax more opaque than in female. Pubescence whiter and a little longer than in female, and rather abundant on cheeks and pleura. A little black hair present on sides of face and behind summit of eyes. The parameres of stipites broadly and semiovally dilated beyond the constricted base, the dilated part being almost straight on outer margin and evenly rounded within. Basal fused part of sagittae large, triangular, depressed and gently convex above, then rapidly attenuating toward apex, with the two component parts thin, opposed, and ending in an acute, slightly upturned point, which projects a little beyond apex of the stipital parameres. Length 7.5 mm.; anterior wing about 6 mm.

*Types*.—U.S.N.M. No. 59281. Holotype (female) and 11 paratypes (female) from Stanford University, Calif., 8, including holotype, taken on March 26, 3 on March 21, and 1 on April 27, 1915 (Harold Morrison); allotype (male), Corte Madero Creek, Stanford University, April 4, 1915 (Morrison); 2 paratypes

(females), San Geronimo, Marin County, April 23, 1913 (J. C. Bridwell); and 1 paratype (female), Russelman Park, Contra Costa County, on *Baeria*, April 26, 1942 (E. G. Linsley).

ANDRENA (ANDRENA) PALPALIS, new species

This species is blue green in both sexes, with pubescence mainly whitish, the abdomen fasciate, and the clypeus of the male yellowish white. In most characters it agrees with typical *Andrena*, except in the fasciate abdomen, the less corbiculate propodeal floccus, and the white clypeus of the male. Other North American species possessing similar characters are *A. banksi* Malloch, *A. angustella* Cockerell, and *A. quercina* Cockerell, all of which differ from *palpalis* in the black integument. This little group, as exemplified by *palpalis*, differs from *Dactylandrena* in the undeveloped malar space, fasciate abdomen, and compact tibial scopa. *A. quercina* has a basal tooth on outer side of mandible, as in *A. helvola* (Linnaeus), the type of *Andrena*.

*Female*.—Dark blue-green, the venter blackish. Antennae and legs black, the claws ferruginous, the spurs testaceous. Tegulae testaceous brown. Mandibles, except reddish tips, labrum and clypeus, except the extreme upper margin, black. Pubescence dull white, moderately long and dense, but not dense enough to conceal surface of integument. Tergites 2 to 4 each with a narrow, pure-white apical band. Disk of tergites 3 and 4 with short, erect blackish hair, that of 2 with longer whitish hair. Apical fimbria dark brown to fuscous. Hair of legs whitish, becoming partly brownish on outer side of tibiae and tarsi. Scopa of hind tibiae compact, broadly brown above and whitish on lower half, the hairs simple. Hair on inner side of middle and hind tarsi pale brown, that on front tarsi darker brown on both sides. Flocculus of hind trochanters rather dense and whitish. Floccus of propodeum dense, but not much curled, the flanks below the floccus with numerous long, scattered hairs. Process of labrum broadly triangular, with a truncato-emarginate and somewhat nodose apex. Facial foveae moderately broad, reaching level of antennae, dark brown on upper half and whitish below, when viewed from above. Clypeus large, convex, a little dullish but more shining in middle, and with fine, moderately close punctures, which are finer toward the margins and more or less sparser on middle of disk. Sides of face dullish, indistinctly punctured. Frons dull, granular, hardly striate, and impunctate. Mesoscutum dull, minutely granular-tessellate, and finely, rather closely punctured. Scutellum similar but shining. Basal area minutely tessellate like remainder of propodeum. Abdomen shining, more distinctly tessellate at base

of segments, and with extremely minute setigerous punctures. Antennal joint 3 longer than 4 plus 5. Wings dusky hyaline, the stigma and nervures dark ferruginous. Length 9.5–10.5 mm.; anterior wing 7–7.25 mm.

*Male*.—Similar to female, but clypeus yellowish white and flagellum dull ferruginous beneath. Disk of clypeus with two dark dots. In one paratype (from Palmdale) there is a curved, transverse whitish line at anterior corners of face, paralleling the margin of clypeus. Mandibles long, curved, decussate. Cheeks broad and angulate, the angulate portion a little above level of middle of eyes. Antennal joint 3 a little shorter than 4 plus 5. Joint 4 slightly longer than wide and plainly shorter than 5, which nearly equals the following joints. Process of labrum short, nodose, prominent, with a semicircular emargination at apex as seen from in front. Clypeal margin with a small triangular tooth on each side, projecting over base of labrum. Pubescence whitish, sometimes with a little dusky or blackish hair at summit of eyes and on scutellum and posterior part of mesoscutum. Hair on disk of tergites 4 to 6 blackish, that on disk of tergite 2 about as long as that on tergite 1. Tergites 2 to 5 each with a thin white apical band. Hair of legs entirely light. Sculpture about as in the female, except that the clypeus is polished, and with fine, delicate, rather sparse punctures. Form slender, with the head broader than thorax. Length 7.75–9 mm.; anterior wing 6–6.4 mm.

*Types*.—Holotype (female), Palm Springs, Calif., March 9, 1924 (H. S. Smith) in the collection of the Citrus Experiment Station. Allotype (male), Palm Springs, February 25 (Hubbard and Schwarz), U.S.N.M. No. 59282.

Paratypes, in the collection of the Citrus Experiment Station: 2 females, The Gavilan, Riverside County, on *Phacelia distans*, April 18, 1937; 1 male, Riverside, on same flower, March 21, 1936; 1 male, Riverside, on *Calandrinia*, March 8, 1932; 1 male, Andreas Canyon, near Palm Springs, on *Phacelia distans*, March 5, 1933 (Timberlake); 1 male, same locality, on *Cryptantha*, March 14, 1942 (Cockerell); and 2 males, Palmdale, San Bernardino County, April 11, 1936 (R. M. Bohart).

The name *palpalis* has reference to the fact that the third joint of the labial palpi is inserted near the middle of the second joint, and the fourth joint before the apex of the third.

ANDRENA (SCOLIANDRENA) CRYPTANTHAE, new species

Closely allied to *A. osmioides* Cockerell, which is the type species of *Scoliandrena* Lanham. It is easily distinguished from



*osmioides* by the mainly black color. It is similar to *A. perplexa* Smith and *A. viburnella* Graenicher in having the broad facial foveae a little separated from margin of eyes, the abdomen finely and closely punctured, the apical depression of tergites hairless, the basal process of labrum large, triangular, and truncated at apex, but it differs in the dense opaque sculpture of the head and thorax, in the short, nearly straight floccus of propodeum, and in having hooked hairs on the mouth-parts.

*Female*.—Black, the abdomen slightly tinged with purplish blue. Mandibles and tegulae rufopiceous, the flagellum reddened beneath, the small joints of tarsi dark ferruginous. Wings dusky, the nervures nearly fuscous, the stigma with a central reddish streak. Head considerably broader than long. Process of labrum large, triangular, and rather narrowly truncated at apex. Antennal joint 3 equaling the next three joints together. Maxillary and labial palpi very short. Apical lobes of maxillae and apical part of labium (the prementum) set with stiff, erect hairs, curled over at their tips; the basal joint of labial palpi with a tuft of similar hair on its outer side. Facial foveae about three-fourths as wide as space between eye and lateral ocellus, and extending to level of top of clypeus. Head and thorax opaque, only the metapleura and pleura of propodeum shining. Clypeus with dense, obscure punctures; the frons substriate. Mesoscutum and scutellum densely punctured, with the basal half of scutellum more shining and sparsely punctured. Mesopleura and dorsal surface of propodeum granular-tessellate. Abdomen dull, with fine, strong, close punctures, which invade the basal portion of the apical depressions. The latter minutely tessellate, shining, with the impunctate, shining portion very narrow on tergite 1, but much broadened in middle on following segments, especially on tergite 4. Pubescence cinereous, moderately dense, and rather short on mesonotum. Hair covering dorsal surface of propodeum (except basal area) nearly as long as that on the mesopleura, hardly curled on each side, where it descends slightly on the pleural surface; the posterior half of the propodeal pleura with a few simple, erect, scattered hairs. Hair on outer side of basitarsi and on front and middle tibiae tinged with brownish fuscous. Hair of hind femora and lower half of tibial scopa white, the upper half of scopa more or less brownish. Scopa moderately compact, with long hairs curling upward from lower side. Flocculus of hind trochanters white, scanty, and rather short. Abdomen without hair bands, the hair short, suberect, and rather dense on disk of segments, becoming longer at basal margin of apical



depressions, especially on tergite 4, but the depressions themselves hairless. Apical fimbria brown, overlaid with paler hairs. Facial foveae whitish and slightly tinged with brown at upper end. Length 10.5–12 mm.; anterior wing 8–8.4 mm.

*Male*.—Similar to female, especially in color of pubescence and in sculpture. Black, the flagellum and small joints of tarsi a little reddened. Head broader than long and wider than thorax. Cheeks very broad and subangulate, the angle opposite the upper end of the anterior third of eyes. Mandibles rather long, decussate, with the inner tooth about the usual distance from apex. Process of labrum large, little elevated, the truncated apex slightly foveato-emarginate. Antennae moderately long, the third joint as long as the next two together. Clypeus opaque, with fine, dense, obscure punctures. Frons opaque, not striated. Mesoscutum a little less closely punctured and more shining on posterior middle than in female, and metapleura and sides of propodeum duller. Abdomen rather shining; comparatively sparsely and much more minutely punctured than in female. The impunctate, finely tessellate, and hairless apical margins broad and conspicuous on tergites 1 to 5. Genital armature similar to that of *A. osmioides*, but parameral lobes of stipites less deeply concave on outer surface, the apical oblique truncation a little shorter, with the angles on each end of the truncation less broadly rounded. Apical process of ninth sternite slightly dilated at tip, the apex rounded, with a small median notch. Pubescence much longer and denser than in female, copious on face and cheeks but not concealing surface. Hair of abdomen longer and sparser in female, and rather long on the first tergite. Pubescence cinereous, not darkened on legs and at apex of abdomen, but slightly tinged with brown on vertex and behind summit of eyes. Hair on inner side of basitarsi dark ferruginous. Length 8–10 mm.; anterior wing 6.4–7 mm.

*Types*.—U.S.N.M. No. 28526. Holotype (female), San Bernardino County, Calif., in May (Coquillett). Allotype, in the collection of the Citrus Experiment Station, taken at Riverside March 14, 1939.

Paratypes in the collection of the University of California at Riverside and at Berkeley: 12 males, 32 females, Riverside, the males taken from March 5 to April 6, the females from March 13 to May 19; 7 males, 26 females, The Gavilan, Riverside County, April 7 to May 4; 4 females, 1½ miles west of Perris, April 7 to May 4; 1 male, 7 females, 4 to 4½ miles west of Perris, March 27 to April 10; 4 females, Ortega Highway, Santa Ana Mountains, overlooking Elsinore, April 28; 2 females, 6 miles

east of Temecula, May 9; 1 male, 2 females, Warner Hot Springs, May 9; 3 females, 3 miles west of Newton, San Diego County, April 14; 2 females, Puente Hills, near Whittier, February 26 and May 9; Forest Home, San Bernardino Mountains, July 5; 1 female, near Keen Camp, San Jacinto Mountains, June 3, all on *Cryptantha intermedia*; 1 male, Palm Springs, on *Cryptantha barbiger*a, March 30 (Timberlake); 1 female, Idyllwild, May 26, 1936, and another, June 3, at Herkey Creek, San Jacinto Mountains; 4 males, La Crescenta, Los Angeles County, April 19, 1936; 3 females, Mint Canyon, Los Angeles County, May 8, 1936; and 1 female, 5 miles north of San Bernardino, San Bernardino County, May 26, 1936, all on *Cryptantha* (E. G. Linsley).

ANDRENA (OLIGANDRENA) ANGELESIA, new species

As in other members of the *Oligandrena* group, the hair of the propodeum in this species is very short and not corbiculate. The flocculus of hind trochanters is also short and straight. From *A. macrocephala* Cockerell and *A. nigroclypeata* Linsley, the female of *angelesia* differs in having only a trace of blackish hairs. The male has the head more transverse than in *macrocephala*, with broader, more angulate cheeks, the mandibles more slender and gently curved, the clypeus only partially yellow, and the third antennal joint little longer than the fourth.

*Female*.—Black, the small joints of tarsi ferruginous, the mandibles and malar space a little reddened, the flagellum more or less reddish brown toward apex, and the spurs brownish testaceous. Tegulae dull ferruginous. Wings dusky hyaline, the nervures fuscous, the stigma with a reddish central streak. Labrum short and transverse, its apical margin gently curved and sharply margined. Basal process of labrum low, very broad, and rounded. Disk of labrum transversely grooved beyond the process. Malar space short and transverse. Facial foveae broad and ending at level of top of clypeus. Antennal joint 3 nearly as long as the next three joints together. Head dull, minutely tessellate, the clypeus, especially toward apical middle, more shining, and closely and shallowly punctured, the punctures fainter toward the margins. Frons closely and rather obscurely striate. Thorax minutely granular-tessellate, opaque and impunctate, becoming a little shining on sternum, sides of propodeum, and basal area, which lack the granulation. Basal area small and triangular. Abdomen tessellate, moderately shining, and impunctate except for excessively minute setigerous punctures. Pubescence moderately dense, bright or reddish fulvous on the vertex, mesonotum and metanotum, and dull whitish elsewhere on head and thorax,

but becoming tinged with fulvous on middle of propodeum. A little dusky or blackish hair on each side of vertex and behind summit of eyes. Facial foveae dull whitish, tinged with brown. Hair of legs whitish, becoming fuscous on outer side of middle tibiae and on middle and hind basitarsi. Hair on inner side of tarsi brownish ferruginous. Scopa of hind tibiae white, ample, moderately compact, the hairs entirely simple, those on lower margin long and curved upward, those on dorsal margin becoming tinged with fuscous toward the base. Abdomen without bands, the hair rather short and thin, blackish on disk of tergites 3 to 5, and whitish and longer, especially on each side, on the apical margin of tergites 2 to 5. Hair of tergites 1 and 2 entirely dull white. Apical fimbria brown or fuscous. Sides of propodeum entirely nude. Length, about 11.5 mm.; anterior wing, almost 9 mm.

*Male*.—Colored like the female, but the flagellum of antennae dark, tarsi brownish ferruginous, and disk of clypeus with a transverse yellow mark on anterior half. Margin of yellow mark more or less distinctly notched in middle and on each side above. Pubescence considerably longer and much looser than in the female, fulvous or ochreous, becoming paler below and on the legs. Hair of abdomen short, thin, and blackish on disk of tergites 3 to 5 and on apical part of tergite 2, that on tergite 1 and along sides of following segments rather long and light. Apical fimbria concolorous with hair of thorax. Head transverse and much broader than thorax, the anterior margin between bases of mandibles convexly arcuate. Mandibles long, simple, moderately stout, and curved. Clypeus more than twice as broad as high. Labrum small, shaped as in female, but without the preapical groove. Process of labrum about twice as broad as long, broadly truncate and more or less emarginate at apex. Antennae rather long and slender, the middle joints of flagellum about one and one-half times longer than thick. Joint 3 slightly longer than either 4 or 5, which are about equal. Cheeks broad and subangulate, the angle well above middle of eye. Sculpture similar to that of female, but less granular, the surface more shining, with setigerous punctures apparent on clypeus, face, cheeks, most of the thorax, and abdomen. Abdomen slender, elongate-oval. Genital armature similar to that of *macrocephala*. Medio-apical lobes of stipites little developed. Parameral lobes large, strongly convergent on basal half, then abruptly angulate on inner margin at the beginning of the elongate, oblong apical expansion, which is slightly tapered to apex. Sagittae slender, depressed, slightly fusiform toward base, and attenuate toward apex. Length 8–9 mm.; anterior wing 6.8–7.3 mm.



*Types*.—U.S.N.M. No. 28522. Holotype (female), Los Angeles County, Calif. (Coquillett). Allotype, in the collection of the Citrus Experiment Station, taken at The Gavilan, April 27, 1938.

Paratypes, in the collection of the Citrus Experiment Station: 5 females, Riverside, 2 on *Encelia farinosa*, 1 on *Cryptantha intermedia*, and 2 on *Platystemon californicus*, March 5 to April 10; 13 males, 5 females, The Gavilan, on *Cryptantha intermedia*, except 3 of the males flying about juniper trees, April 10 to May 4; 4 females, 4 to 4½ miles west of Perris, on *Cryptantha* and *Platystemon*, March 27 and April 10; and 2 males, 1 female, Temecula, on *Cryptantha intermedia*, April 7 (Timberlake).

As far as is known the female collects pollen exclusively from *Platystemon*.

ANDRENA (SIMANDRENA) OPACELLA, new species

This species is allied to *A. nasonii* Robertson and *A. orthocarpi* Cockerell. It agrees with the latter in size, in general appearance, and in the finely sculptured basal area, but it differs in the duller head and thorax, erect hair of clypeus, and fulvous-tinted wings. It agrees with *nasonii* in color of wings and dull mesoscutum, but the basal area is much more finely sculptured, the head broader, with dark foveae, the process of labrum smaller, and the basal nervure opposite the nervulus.

*Female*.—Black, the tarsi more or less reddened. Flagellum only slightly brownish beneath. Mandibles red at apex. Tegulae rufo-testaceous, darker at base. Wings fulvous tinted, the stigma and nervures ferruginous, with the subcosta darker. Pubescence as in *orthocarpi* except hairs of clypeus more erect, not curved forward, and brownish except at sides. Facial foveae seal brown. Tergites 2 to 4 each with a white apical hair band, that on 2 broadly interrupted and that on 3 more narrowly interrupted medially. Apical fimbria light golden brown. Head much broader than long, the facial foveae broad. Process of labrum small, subtriangular, obtuse at apex. Clypeus strongly convex, dull, and roughened with fine papillae or wartlike elevations. Mesoscutum strongly tessellate, subopaque, and with sparse, obscure punctures. Scutellum more shining and more distinctly punctured than the scutum. Basal area tessellate, opaque, its sculpture similar to that of remainder of propodeum. Abdomen somewhat shining, and finely punctured, especially on tergites 1 and 2, the punctures about as in *orthocarpi*, and perhaps a little less distinct than in *nasonii*. Length about 7 mm.; anterior wing 6 mm.

*Types*.—U.S.N.M. No. 59284. Holotype (female) and 2 female paratypes, Mount Hamilton Range, Santa Clara County, Calif., April 26, 1913 (J. C. Bridwell).



One paratype, with same data, in the collection of the Citrus Experiment Station.

ANDRENA (THYSANDRENA) SUBDEPRESSA, new species

Allied to *A. chlorura* Cockerell, but distinct in the large amount of black hair on the head and mesopleura, in the unusually narrow facial foveae, subdepressed clypeus, and shorter antennae.

*Female*.—Head and thorax faintly bluish green, the abdomen dark olive green. Mandibles, labrum, clypeus, antennae, and legs black, the sides of thorax and propodeum almost black. Apex of mandibles dark red, and the tegulae slightly reddened. Wings rather strongly dusky, the stigma and nervures dark reddish, the subcosta black. Head somewhat broader than long. Process of labrum about twice as broad as long, truncate at apex. Antennae short, the joints of flagellum, except the first and last, no longer than wide. Facial foveae linear, narrower than width of flagellum, and reaching level of antennal sockets. Clypeus more produced than in *chlorura*, subdepressed, shining, but not polished, closely and rather finely punctured, the punctures fading out on lateral and dorsal margins. Frons closely striate. Thorax dullish, the mesoscutum somewhat granular-tessellate, and with fine, shallow punctures. Propodeum almost opaque, the basal area minutely granular-tessellate. Abdomen a little less shining than in *chlorura*, but with about the same minute setigerous punctures. Pubescence brownish ochreous, a little paler on the underparts. Hair on each side of face, almost to anterior end of eyes, that on scapes, the thin hair of frons and vertex, that on the temples in part, and a rather large patch on upper part of each mesopleuron, below tegulae, black. Hair on clypeus and middle of face below antennae dusky ochraceous, sometimes with a few black hairs intermixed, but strongly contrasting with the black orbital hair. Hair of face long, especially the black hair of scapes and orbits. Hair of legs mainly light, but a little tinged with brownish on front and middle tibiae and tarsi. The short tuft at apex of hind femora, hair on dorsal margin of hind tibiae especially toward the base, and short, dense tuft of hair at extreme apex of hind tibiae above, fuscous. Hair of abdomen above rather abundant and erect, but not dense enough to obscure the surface. Hair of first tergite long and that of second but little shorter. Apical bands of tergites 2 to 4 thin, concolorous, and not noticeable except when viewed from above. Apical fimbria fuscous. Facial foveae black in frontal view and pale brown when viewed obliquely. Length 9 mm.; anterior wing 7.5 mm.

*Male*.—Similar to female. Head and thorax dark bluish green. Black hair of head and thorax more abundant, the black orbital

hair very long and contrasting with light hair of clypeus. Temples and mesopleura with much black hair. Disk of mesoscutum and scutellum with a few shorter black hairs intermixed. Process of labrium about twice as broad as long, truncato-emarginate at apex. Clypeus not depressed, dullish, closely and shallowly punctured. Antennae extending slightly beyond base of propodeum, the flagellum not at all reddened. First joint of flagellum nearly equaling joints 2 and 3 together. Joint 2 as long as wide, the following joints somewhat longer than wide. Genitalia nearly as in *chlorura*, but the sagittae slightly less broadened across the basal part. Length 7–8.5 mm.; anterior wing 5.6–6.5 mm.

*Types*.—U.S.N.M. No. 59285. Holotype (female), Stanford University, Calif., March 5, 1906 (J. M. Aldrich) and 5 other females (paratypes), from Stanford University, February and March (Aldrich and H. Morrison), 2 of these from wild mustard. Allotype, in the collection of the Citrus Experiment Station, from Berkeley, February 16, 1935 (R. M. Bohart).

*Paratypes*: In the collection of the Citrus Experiment Station, 1 male, 6 females, Berkeley, February and March 1934 and 1935 (R. M. Bohart); in the collections of the University of California at Berkeley and of Dr. U. N. Lanham: 2 males, 1 female, Grizzly Peak Boulevard, Berkeley, February 15, 1939; 5 females, Berkeley, on *Brassica*, March 6, 1947 (J. W. McSwain); and 11 females, Berkeley, on *Brassica*, March 12, 1947 (U. N. Lanham).

ANDRENA (THYSANDRENA) DISSIMULANS, new species

This is a small green fasciate species of *Thysandrena*, similar to *A. suavis* Timberlake, but distinguishable by having the facial foveae broader, the tibial scopa weakly plumose, and the middle basitarsi no wider than the hind pair. The male is easily separated from *suavis* by having antennal joints 3 and 4 subequal in length.

*Female*.—Dark green; the labrum, anterior margin of clypeus, mandibles, antennae, and legs, black. Mandibles dark red on apical half. Flagellum reddish brown beneath, except toward base. Legs slightly brownish, the small joints of tarsi, especially the apical joint, ferruginous. Tegulae testaceous brown, paler at apex. Wings strongly dusky, the stigma and nervures dark reddish, the subcosta piceous. Head much broader than long, the eyes slightly convergent below. Process of labrum rather small, with sloping sides and broadly truncate to rounded apex. Antennal joint 3 barely longer than the next two joints together. Facial foveae dark brown above, appearing whitish below when viewed from behind, moderately narrow, short, contiguous to eye margin and ending distinctly below level of anterior ocellus and thus widely separated from the lateral ocelli. Head and thorax

minutely granular-tessellate and dull. Clypeus and mesoscutum with close, fine, shallow, indistinct punctures. Frons finely striate. Basal area narrowly triangular, with a smoother tessellate sculpture than remainder of dorsal surface of propodeum. Abdomen tessellate, shining, with minute setigerous punctures. Basal nervure usually opposite the transverse median. Second submarginal cell about one-half, or sometimes more than one-half, as long as the third, a little narrowed above, and receiving recurrent nervure at or near the middle. Pubescence whitish or cinereous, moderately dense, and rather short, being longest on the mesopleura. Hair of mesoscutum in part very short, with longer hairs interspersed. Floccus of propodeum about as long as hair of mesopleuron, but little curled, the pleuron beneath the floccus with a few scattered hairs, except at posterior end. Abdomen with short, erect pale hair on disk of segments, becoming much longer on first tergite and at sides of the second. Tergites 2 to 4 each with a whitish, entire, moderately broad, and dense apical hair band. Apical fimbria brown. Hair of legs whitish, that at apex of hind femora above, and at base of hind tibiae on outer side, brown. Scopa of hind tibiae moderately loose, the hairs on lower margin strongly curled upward and weakly plumose, the hairs on dorsal margin about as long as greatest width of tibia and distinctly plumose. Flocculus of hind trochanters short, scanty, but curled. Length 7.5–8.5 mm.; anterior wing 6.5–7 mm.

*Male*.—Similar to female in color and sculpture. Antennae much longer than in female, the joints of flagellum beyond the second nearly twice as long as thick. First and second joints of flagellum subequal and a little shorter than the third. Mandibles short, not decussate. Process of labrum foveately emarginate at apex. Pubescence of head and thorax long and loose, becoming moderately dense on face below antennae and about as long on mesoscutum as on the pleura. A little black hair usually present on sides of face and behind summit of eyes. Pubescence of legs and at apex of abdomen entirely light. Hair of abdomen otherwise as in the female, except that the apical bands are weak. Hair of venter thin and erect, the segments without apical fringes. Length 6–9 mm.; anterior wing 5.2–6.5 mm.

*Types*.—Holotype (female), allotype, and paratypes, 51 males, 22 females, Earlimart, Tulare County, Calif., on *Baeria* and a few on *Calandrinia*, March 9, 1937 (Timberlake and Linsley); 1 female (paratype), same locality, on *Baeria*, March 30, 1937; and 6 males, 3 females (paratypes), Strathmore, Tulare County, on *Baeria*, April 1, 1933, and March 29, 1937 (Timberlake), in



collection of the University at Berkeley (paratypes) and Riverside (types and paratypes), from which a series of paratypes has been transferred to the U. S. National Museum, No. 59286.

ANDRENA (THYSANDRENA) BLANDULA, new species

Similar to *A. dissimulans* but distinguishable by the longer erect hair of the abdomen, with but little indication of hair bands on the middle tergites.

*Female*.—Agreeing with *A. dissimulans* in most respects, but differing as follows: Pubescence a little longer, especially on the mesoscutum and tergum of abdomen. Tergites 1 to 4 with erect hair, rather long on 1 and gradually decreasing in length toward apex of abdomen. Hair at apex of tergites a little depressed but not forming distinct hair bands. Facial foveae fuscous in frontal view, but pallid, with a brownish tinge, as seen from above. Wings slightly less dusky, with light red stigma and nervures. Basal nervure slightly postfurcal. Second submarginal cell quadrate, a little more than half as long as the third, and receiving the recurrent nervure slightly before the middle. Both species have golden and reddish reflections on clypeus above the black anterior border. Length 7.5 mm; anterior wing 6.8 mm.

*Type*.—U.S.N.M. No. 59287. Holotype (female) collected on Mount Hamilton Range, Santa Clara County, Calif., April 26, 1913 (J. C. Bridwell).

ANDRENA MISELLA, new species

This species is similar to *A. anisochlora* Cockerell in size, color, and very dull sculpture of the head and thorax, but they cannot be closely allied. In the broad process of labrum, narrow foveae, short and nearly straight floccus of sides of propodeum, and small incomplete flocculus of hind trochanters, it agrees well with *A. merriami* Cockerell, *A. fulvinigra* Viereck and Cockerell, and *A. nigrihirta* (Ashmead), but it differs in having the clypeus very dull and impunctate, and the hair of the abdomen abundant and erect. The *merriami* group is placed by Lanham near the subgenus *Gymnandrena* and probably will deserve recognition as a subgenus when better known.

*Female*.—Black, the abdomen faintly dark green. Mandibles at apex and small joints of tarsi a little reddened. Flagellum slightly brownish beneath. Tegulae dark castaneous at apex. Wings dusky hyaline, stigma and nervures dusky brown, the subcosta blackish. Head a little wider than long. Labrum short and broad, with a transverse groove before the large, broadly truncate basal process. Facial foveae rather narrow, parallel sided, and reaching level of antennae. Antennal joint 3 about



equaling the next three joints together. Head and thorax opaquely sculptured. Clypeus and sides of face below antennae with close, shallow punctures. Frons finely striate. Thorax granular-tessellate and indistinctly punctured. Basal area small, triangular, minutely tessellate. Remainder of propodeum and abdomen with minute, craterlike, setigerous punctures. Second submarginal cell quadrate, half as long as the third, and receiving the recurrent nervure at the middle. Floccus on each side of propodeum rather short and nearly straight, the pleural surface beneath with shorter and scattered hairs. Flocculus of hind trochanters short and incomplete. Pubescence whitish to ochreous on occiput, mesonotum and metanotum, and tegulae, otherwise black on the head and thorax, including a tuft of short black hair on tegulae. Hair of abdomen black, erect, moderately long and dense, with some light hair on apical middle of tergite 1, on middle of tergite 2, and on the middle of apical margin of tergites 3 and 4. Hair of venter dark. Hair of legs almost entirely dark, the scopa of hind tibiae a little tinged with brown. Hair on inner side of the basitarsi glistening chocolate brown. Tibial scopa moderately long and dense. Facial foveae chocolate brown, when viewed from above, and black in frontal view. Length 8.5–9 mm.; anterior wing 6.5 mm.

*Type*.—U.S.N.M. No. 59288. Holotype (female), Berkeley, Calif., February 29, 1934 (R. M. Bohart).

Paratypes, in the collections of the University of California at Riverside and at Berkeley: 1 female, Berkeley, February 24, 1939 (Bohart); 1 female, Lindsay, on *Amsinckia eastwoodae*, April 1, 1933 (Timberlake); 3 females, 6 miles west of Tracy, March 4, 1948 (J. W. MacSwain and P. D. Hurd); and 14 females, Westley, Stanislaus County, on *Brassica*, April 1, 1948 (P. D. Hurd).

#### Genus MEGANDRENA Cockerell

In his recent study of the North American Andrenidae, Lanham<sup>3</sup> recognizes *Megandrena* as a good genus and reduces *Ancylandrena* to subgeneric rank.

#### MEGANDRENA (ANCYLANDRENA) LARREAE, new species

This species agrees with *M. atoposoma* (Cockerell) in many ways, but differs in having the mesoscutum and abdomen more finely and closely punctured, the pubescence generally fulvous, with little fuscous or blackish hair, and the white lateral face marks of the male triangular.

*Female*.—Black, with the tips of mandibles, flagellum beneath, and small joints of tarsi dull ferruginous. Tegulae dark brown.

<sup>3</sup> Univ. California Publ. in Ent., vol. 8, pp. 183–238, 1949.

Wings dusky hyaline, the stigma and nervures dark ferruginous (these parts piceous in paratypes, excepting those from Inyo County). Tibial spurs testaceous yellow. A small transverse blister at base of mandibles, yellowish. Pubescence of head and thorax denser than in *atoposoma*, whitish on face, cheeks, underside of thorax, and fulvous or fulvo-ochraceous on vertex, mesonotum and metanotum, with hair of propodeum similar but paler. Tergites 1 to 4 each with a dense, white apical hair band, and the disk of tergites 2 to 4 between the bands with rather dense, short, erect black hair. Disk of tergite 1 in front of the band with long, erect hair, which is white or slightly tinged with fulvous. Fimbria pale chocolate brown, shading into whitish at the sides and base of the fifth segment. Hair of legs fulvo-ochraceous, more whitish on the femora, and becoming ferruginous on front tarsi and on underside of middle and hind basitarsi. Facial foveae pale brown, broad, reaching nearly to lateral ocelli, but failing to reach level of antennae. Process of labrum broader than long, with a large triangular emargination at apex. Clypeus polished and prominent, with the transverse anterior groove strongly arcuate and receding from the margin on each side. Disk of clypeus gently convex and nearly impunctate, except for a group of fine punctures on each side of a slightly ridged median space on the upper half. Sides of face below antennae, frons, and almost all of the thorax finely and closely punctured. Abdomen still more finely and closely punctured than thorax. Antennae longer than in *atoposoma*, with the middle joints of flagellum a little longer than thick. Length, about 11–12 mm.; anterior wing 7.5–8 mm.

*Male*.—Black, with the white lateral face marks triangular, broad below and coming to a point at level of antennae. Clypeus more prominent and more produced beyond base of mandibles than in *atoposoma*. Mandibles with a transverse testaceous blister at base on outer side. Antennae longer than in *atoposoma*, the joints of flagellum nearly twice as long as thick. Sides of face, frons, and almost the whole thorax and abdomen finely and closely punctured, the punctures rather dense on notum of thorax and tergum of abdomen, so that the surface is considerably less shining than in *atoposoma*. Pubescence long, white, and dense, being denser than in *atoposoma*, with some fuscous or black hairs intermixed on the posterior middle of mesoscutum and on the scutellum. Hair of abdomen long and erect, not forming bands, and longer on the first segment and at sides of the seventh than elsewhere. Some short, fine fuscous hair intermixed at the extreme base of at least tergites 5 and 6. Pygidial plate of seventh tergite triangular, very acute at apex, the broad basal half with a median carina, but this carina much

less raised and less tectiform than in *atoposoma*. Wings more glassy hyaline, with the fine, short, dark-colored discal setae much sparser than in *atoposoma*, especially in the submarginal and discoidal cells. Genital armature very nearly identical in the two species. Length 9.5–11 mm.; anterior wing 7.4–7.8 mm.

*Types*.—U.S.N.M. No. 28559. Holotype (female) and allotype, Panamint Valley, Inyo County, Calif., April 1891 (A. Koebele).

*Paratypes*: In the collection of the Citrus Experiment Station: 1 female, Palm Springs, March 10, 1935; 2 males, 1 female, Andreas Canyon, near Palm Springs, March 24, 1932; 7 males, 1 female, Palm Canyon, Borego Valley, San Diego County, March 29, 1936; 1 female, 4 miles south of Victorville, June 4, 1938 (Timberlake); 8 males, 4 females, Tahquitz Canyon, near Palm Springs, March 24, 1936 (C. M. Dammers); and 1 female, Picture Rocks, Pima County, Ariz., May 6, 1935 (A. J. Basinger). In the Bohart collection: 4 males, 1 female, Tahquitz Canyon, near Palm Springs, April 16, 1938 (R. M. and G. E. Bohart); 1 male, Westgard Pass Plateau, Inyo Mountains May 27, 1937 (L. D. Phillips); and 1 male, Mazourka Canyon, Inyo Mountains, May 25, 1937 (N. W. Frazier). In collection of the University of California at Berkeley: 1 female, 2 miles east of Cathedral City, April 10, 1936; 2 males, Box Canyon, Riverside County, April 4, 1937; and 1 male, Palm Canyon, Borego Valley, San Diego County, March 29, 1936 (E. G. Linsley).

This bee visits the flowers of *Larrea divaricata*, from which the female collects pollen.

MEGANDRENA (ANCYLANDRENA) KOEBELEI, new species

This differs from the two other species of *Ancylandrena* in having the basal half of mandibles and large mark on clypeus creamy white, the blister on base of mandibles very large, and a large patch of brown hair present on the mesoscutum.

*Male*.—Black, the basal half of mandibles, clypeus except broadly at sides and on anterior margin, and triangular lateral marks ending acutely above level of antennae, creamy white. Apex of mandibles, flagellum beneath, tubercles, tegulae, metapleura, sides of propodeum, legs and venter dark ferruginous; the sternum and mesopleura less reddened. Apical margin of tergites broadly subhyaline. Pubescence white, long, fine, silky, and rather dense, mainly concealing surface of face and mesonotum, and only a little less dense on other parts. Hair of vertex, that on apex of tegulae, and a large quadrate patch on posterior half of mesoscutum, brown. Hair on the basal half of tergites 2 to 5 fuscous or black, contrasting with the white hair



at apex of segments. Hair of cheeks, tibiae, and basitarsi especially long, and that on inner side of basitarsi short and golden. Wings faintly dusky, the stigma and nervures ferruginous, the subcosta blackish. Stigma very narrow. Basal nervure slightly postfurcal. Second submarginal cell large, longer than high and receiving the recurrent nervure at one-third of its length before the apex. Antennae reaching base of scutellum, the middle joints of flagellum nearly twice as long as thick. Antennal joint 3 nearly as long as 4 plus 5, joint 4 being barely longer than thick. Ocelli slightly enlarged. Sculpture throughout extremely fine, consisting of close, setigerous punctures, the surface mainly shining. Median ridge on disk of clypeus and the apical half of disk polished and impunctate. Pygidial area of tergite 7 well elevated, almost carinate laterally, narrowly triangular, nude, and black, the remainder of the tergite ferruginous and hairy. Genital armature very similar to that of *larreae*, but the lobes of the stipites a little more incrassate and ending more bluntly. Length 11 mm.; anterior wing 7.5 mm.

*Type*.—U.S.N.M. No. 28560. Holotype (male), Panamint Valley, Inyo County, Calif., April 1891. (A. Koebele).







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# THE ACTINIAN FAUNA OF THE GULF OF CALIFORNIA

BY OSKAR CARLGREN

OUR knowledge of the actinian fauna of Baja California and the west coast of Mexico is very incomplete. Verrill (1869) mentioned with some doubt the occurrence of *Epizoanthus elongatus*; in 1893 McMurrich described *Anemonia* ? *inequalis* (probably a *Gyrostoma* McMurrich, 1904), *Oulactis californica*, and *Cerianthus vas*; in 1902 Gravier described a pelagic cerianthid, *Dactylactis benedeni*; in 1940 I proposed three species, *Alicia beebei*, *Nemanthus californicus*, and *Actinothoe californica*. Thus, up to this time only eight species of actinians were known from these districts.

The present paper is the result of an examination of a collection made by E. F. Ricketts during a cruise in the Gulf of California in 1940. The collection is rather large, containing, according to my opinion, 28 species, 16 of which are Actiniaria (including 3 new genera and 8 new species), 2 are Ceriantharia (one a new species), and 10 are Zoantharia (of which 9 are new species). Some species seem to be identical with those described by Verrill in 1869 from the coast of Panama. Unfortunately, Verrill's descriptions of his species are very incomplete, inasmuch as he usually described only the exterior and the color. I think, however, that my identifications of his species of Actiniaria are correct as a whole, but I am not certain of the Zoantharia. Identification of Verrill's species of this group is very difficult.

All the types and most of the specimens mentioned under collecting records are in the United States National Museum.

## Order ACTINIARIA

## Family HALCAMPOIDIDAE

## CALAMACTIS, new genus

Elongate Halcampsoididae with well-developed physa. Column smooth, not divided into regions. No sphincter. Tentacles few, rather short. A single siphonoglyph fairly well developed. All 12 pairs of mesenteries perfect and filamentous, the first cycle of mesenteries fertile, the second sterile. Retractors very strong, reniform. The same number of mesenteries proximally and distally. Cnidom: spirocysts, basitrichs, microbasic *p*-mastigophors.

## CALAMACTIS PRAELONGUS, new species

FIGURE 78, *a*, *b*

Tentacles 24. Retractors of the mesenteries of the second cycle weaker than those of the first but of same appearance. Basitrichs of the column 14–17 by  $2.8\text{--}3\ \mu$ ; those of the tentacles 18.3–21 by  $3\text{--}3.5\ \mu$ ; those of the actinopharynx 19–26.2 by  $2.8\text{--}4\ \mu$ ; those of the filaments partly 10.6–12 by about  $2.2\ \mu$ , partly 24–31 by  $5\text{--}5.6\ \mu$ , the latter broad in their basal end. Microbasic *p*-mastigophors of the actinopharynx 17–24 by  $4.2\text{--}5\ \mu$ ; those of the filaments 18.3–25 by  $4.2\text{--}5\ \mu$ .

*Measurements*.—Length 7 cm. in contracted and very deformed condition.

*Holotype*.—U.S.N.M. No. 49453, Estero de la Luna, Sonora, Mexico, April 10, 1940.

*Remarks*.—The single specimen is strongly contracted, deformed, and turned inside out. Figure 78, *a*, shows the appearance of a retractor; 78, *b*, of a parietal muscle of the first cycle.

## Family ANDVAKIIDAE

## ANDVAKIA INSIGNIS, new species

FIGURE 78, *c*, *d*

Column divisible into physa, scapus, and scapulus. Scapus with tenaculi incrustated with grains of lime-sand and foraminifers. The sphincter is mesogloal, very long but weak, stronger in its uppermost and lowermost parts, between which consisting of a single row of meshes, wholly separated from the endodermal muscles of the column and situated either in the middle of the column or nearer the ectoderm. Tentacles about 24, short, their longitudinal muscles ectodermal. Siphonoglyphs indistinct. Six perfect and fertile pairs of mesenteries and five pairs of imperfect ones; on the one side of a directive mesentery a pair of the second cycle is



lacking. The mesenteries of the second cycle may have filaments. Retractors of the perfect mesenteries very strong, reniform to circumscribed, with high, branched folds (fig. 78, *c*). The parietal muscles (fig. 78, *d*) are well developed but are not distributed on the column. The mesenteries of the second cycle resemble the parietal muscles of the primary mesenteries. Nematocysts of the tentacles partly 10–15.5 by 1.5–2  $\mu$ , partly 19–26.8 by 2.2–2.5  $\mu$  (both basitrichs), those of the actinopharynx partly 24–26.8 by 2.8–3  $\mu$  (basitrichs), partly 24–28 by 5–7  $\mu$  (microbasic *p*-mastigophors), partly 31–39.5 by 5.6–7  $\mu$  (probably microbasic amastigophors); those of the filaments 15.5–18.3 by 2.8–4  $\mu$  (microbasic *p*-mastigophors); those of the acontia partly 15.5–18.3 by 1.5  $\mu$  (basitrichs), partly 42.3–49.3 by 5.6–7  $\mu$  (microbasic amastigophors).

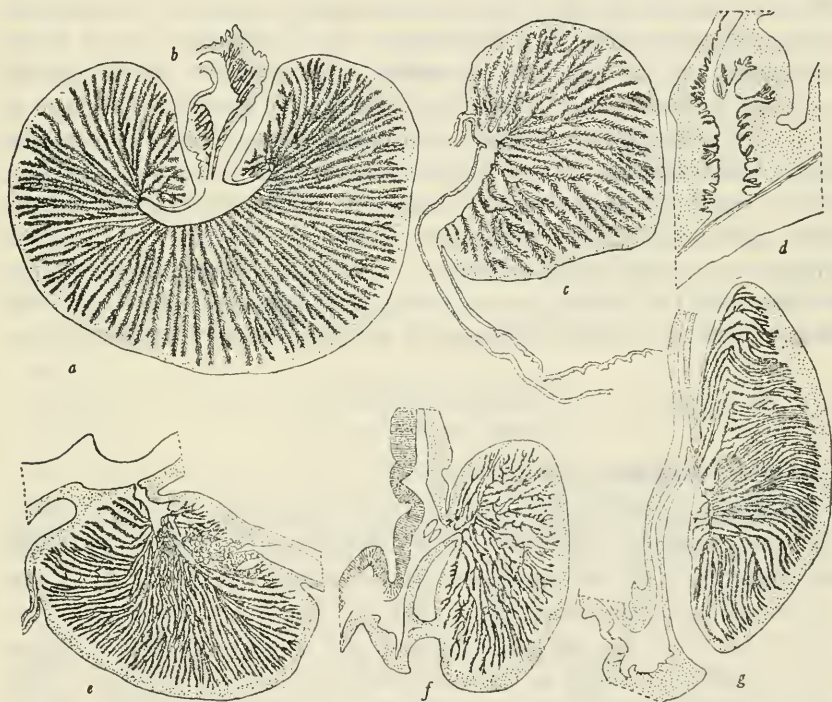


FIGURE 78.—*a, b*, *Calamactis praelongus*, new species: *a*, Retractor; *b*, parietal muscle of first cycle. *c, d*, *Andvakia insignis*, new species: *c*, Retractor of perfect mesentery; *d*, parietal muscles. *e, f*, *Anthopleura dowii* Verrill, sphincter of two specimens. *g*, *Bunodosoma californica*, new species, sphincter.

*Measurements*.—Length about 1.2 cm., breadth 0.4 cm.

*Cotypes*.—Two specimens, U.S.N.M. No. 49442, Gabriel Bay, Espíritu Santo Island, April 12, 1940.

*Remarks*.—The proximal end of one specimen is invaginated, that of the other is visible. I have sectioned the most proximal

part of the body in order to find out if there is a physa or a pedal disc proper. If the former is present, the species is an *Andvakia*; if the latter, it may be referred to the family Isophelliidae. Although it is very difficult to determine whether basilar muscles are present in specimens having a small proximal end, and a mistake could easily be made, I think the basal end is a physa. I do find muscles resembling basilar muscles, but they seem to run together with the parietal muscles, of which they may be the most proximal part. Likewise, the families Andvakiidae and Isophelliidae are closely related to each other. The species of the latter family have very likely originated in forms having a physa, as do the andvakiids. It is possible that the genus *Capneopsis* Duchassaing and Michelotti is identical with *Andvakia* and that it is provided with a physa, which the animal has usually drawn in. *Capneopsis solidago* Duchassaing and Michelotti, like *Andvakia parva* Carlgren, seems to be attached to stones and shells but in *A. parva* the physa is visible only when the animal is in motion. Perhaps it is so with *Capneopsis* (which, according to authors, resembles *Edwardsia*), though it was adherent to rocks. Moreover, the two species resemble each other very much in their exterior and in their anatomy. I have mentioned (1934, p. 32) that the basilar muscles are weak in *C. solidago*. I may have confused basilar muscles with the lowest part of the parietal muscles. In that event the genus may be called *Capneopsis* and the family Capneopsiidae.

### Family ALICHIIDAE

ALICIA BEEBEI Carlgren

*Alicia beebey* CARLGREN, 1940, p. 211.

The single specimen is considerably larger than the small type. The nematocysts are also larger throughout. The microbasic amastigophors of the vesicles are 67.7–84.6 by 10–11.3  $\mu$ , the microbasic amastigophors 80.4–86.8 by 8.5–9.2  $\mu$ , the basitrichs 18.3–21 by 2.8–3.5  $\mu$ , the microbasic amastigophors of the tentacles are 53.6–59.2 by 7–8.5  $\mu$ , the basitrichs 16.9–21 by 2.5–2.8  $\mu$ , the nematocysts of the actinopharynx 43.7–66 by 6.3–7  $\mu$ , the microbasic amastigophors of the filaments are 35.2–45 by about 7  $\mu$ , the microbasic *p*-mastigophors 7–12.7 by 3.5–4  $\mu$ . In my paper of 1940, p. 212 line 4, “mesenteries 96” should be followed by “; 6.”

*Measurements*.—Length of the column 8.5 cm., breadth of pedal disc 6–7 cm., length of tentacles up to 12 cm., breadth up to 0.2 cm.

*Collecting record*.—Puerto Escondido, found pelagic in tide pool, March 26, 1940, 1 specimen.

*Additional distribution record*.—Arena Bank, Baja California.

## Family ACTINIIDAE

## PHYMACTIS CLEMATIS (Drayton)

*Actinia clematis* DRAYTON, in Dana, 1846, p. 130, pl. 1, figs. 4, 5.

*Phymactis clematis* MILNE-EDWARDS, 1857, p. 275.—VERRILL, 1869, p. 476.—

CARLGREN, 1898, p. 17; 1922, p. 145.—McMURRICH, 1904, p. 259.

*Actinia florida* DRAYTON, in Dana, 1846, p. 131, pl. 2, figs. 6–8.

*Phymactis florida* MILNE-EDWARDS, 1857, p. 274.—VERRILL, 1869, p. 476.

The nematocysts of the two small specimens agree fairly well with those of the individuals from Juan Fernández (Carlgrén, 1922, p. 146), but those of the marginal spherules are shorter in the latter. The atrichs of the marginal spherules are 48–77.6 by 4.2–5.6  $\mu$  and 36.7–70.5 by 4.2–5.6  $\mu$  respectively in the two specimens and the very common basitrichs 53.6–87.4 by 2.8  $\mu$  and 51–86 by 2.8  $\mu$  respectively. In a specimen of about the same size from Juan Fernández, the atrichs are 41–67 by 4.2–6  $\mu$ , the basitrichs 49.3–76 by 2.8  $\mu$ . The nematocysts of the vesicles in the larger specimen are 17–21 by 2.5–3  $\mu$  (basitrichs, common); those of the tentacles 18.3–26.8 by 2.5–2.8  $\mu$  (basitrichs, very numerous); those of the actinopharynx partly 18.3–33.8 by about 2.8  $\mu$  (basitrichs), partly 19.7–24 by 4.2–5.6  $\mu$  (microbasic *p*-mastigophors); those of the filaments partly 10–12.7 by about 2.2  $\mu$ , partly 21–36 by 3.5–4.2  $\mu$  (both basitrichs), partly 19–23.3 by 4.2–5.6  $\mu$  (microbasic *p*-mastigophors).

*Collecting record*.—Puerto Escondido, March 26, 1940, two specimens.

*Additional distribution record*.—Ecuador; Peru; Juan Fernández, Chile.

*Remarks*.—The present habitat is the northernmost known. The small size of the specimens indicates that the species has reached the limit of its distribution toward the north.

## ANTHOPLEURA DOWII Verrill

FIGURE 78, *e, f*

*Anthopleura dowii* VERRILL, 1869, p. 474; 1899, p. 44, fig. 8.

The six specimens in the collection are undoubtedly *A. dowii*. The color of the tentacles is greenish with light spots in the largest specimen. The exterior is well described by Verrill: "The pores through which water may be ejected" are certainly those of the marginal spherules. The sphincter is almost palmate in the two specimens examined (fig. 78, *e, f*). In the largest specimen there are 2 broad siphonoglyphs symmetrically set and strongly prolonged aborally, 24 pairs of perfect and fertile mesenteries including the directives and 24 pairs of imperfect, sterile, and filamentous



mesenteries. At the base 96 mesenteries and about the same number of tentacles are present. The retractors of the perfect mesenteries are bandlike; the parietobasilar muscles strong, forming a distinct shelf; the basilar muscles well developed. I have examined the nematocysts of the tentacles and marginal spherules in three specimens, the nematocysts of the other parts of the body in two. The nematocysts of the marginal spherules are partly 41–60 by 5.6–7  $\mu$  (atrichs), partly 41–56 by 2.8–3.5  $\mu$  (basitrichs); those of the column 10–22.6 by 1.52–2.8  $\mu$  (basitrichs, probably two kinds); those of the tentacles 19.7–26.8 by 2.5–3  $\mu$  (basitrichs); those of the actinopharynx partly 21.8–31 by 3–3.5  $\mu$  (basitrichs), partly 19.7–22.6 by 4.2–5.6  $\mu$  (microbasic *p*-mastigophors); those of the filaments partly 32.4–42.3 by 5–5.6  $\mu$ , partly 11.3–17 by 1.5–2.5  $\mu$  (both basitrichs), partly 19.7–25.4 by 4.2–5.6  $\mu$  (microbasic *p*-mastigophors).

*Measurements.*—The largest specimen, pedal disc 4 by 2 cm., height of column about 5 cm.

*Collecting records.*—Puerto Escondido, March 26, 1940, one specimen, the largest; Angeles Bay, April 1, 1940, two specimens; San Carlos Bay, Sonora, Mexico, April 4, 1940, three specimens.

*Additional distribution records.*—Panama; Rialejo; Pearl Islands; El Salvador.

BUNODOSOMA CALIFORNICA, new species

FIGURE 78, *g*

The pedal disc is well developed but narrower than the oral disc. The whole column is provided with closely set vesicles, as in other species of the genus. The fosse is shallow, the sphincter well developed and circumscribed, of almost palmate type, or with a short, thin main lamella. In figure 78, *g*, I have illustrated the sphincter of a specimen from Angeles Bay; sections of specimens from Point Lobos and Tiburón Island indicate similar sphincters. The three specimens from Puerto Escondido and the one from Tiburón Island have marginal spherules in the fosse; the other specimens apparently do not, but if they are present they must be very rare.

The number of tentacles ranges between 120 and 146 in the four larger specimens. The oral disc is wider than the pedal disc and in the very contracted specimen from Point Lobos it is folded, mainly because of the strong contraction of the body. The longitudinal muscles of the tentacles are well developed and ectodermal. The number of siphonoglyphs varies: the specimen from Tiburón Island has three; two individuals from Angeles Bay and the specimen from Port Lobos two, symmetrically set (those from



the latter not examined in regard to directives); two individuals from Puerto Escondido are provided with three and six siphonoglyphs, only one joined with directives. There are numerous perfect mesenteries; I counted 46 pairs in one specimen. There are more mesenteries at the base than at the margin. The retractors of the mesenteries are diffuse and not strong, the parietobasilar muscles distinct. The nematocysts of the marginal spherules are partly 32.4–48.6 by 4.2–5.5  $\mu$  (32.4–42.3 by 4.2–5  $\mu$ , 38–47.9 by 5.5  $\mu$ , 39.5–47.5 by 5–5.5  $\mu$ , 39.5–48.6  $\mu$ ) (atrichs), partly 24–25.4 by 2.8  $\mu$  (few basitrichs in the one individual examined); those of the vesicles 16.9–31 by 2.5–4.2  $\mu$  (basitrichs, probably two kinds); those of the tentacles 24–29.6 by 2.8–3  $\mu$  (basitrichs); those of the actinopharynx partly 23.3–33.8 by 3–3.5  $\mu$ , partly 12.7–16 by 2.2–2.8  $\mu$  (both basitrichs); those of the filaments partly 11.3–17.6 by 1.5–2.2  $\mu$ , partly 32.4–38.8 by 5–7  $\mu$  (both basitrichs), and partly 19.7–26 by 4.2–5.6  $\mu$  (microbasic *p*-mastigophors in 12 specimens from Tiburón Island and Point Lobos examined).

*Measurements.*—The very contracted specimen from Point Lobos, oral disc 4 cm., height 1.7 cm.; an individual from Angeles Bay, breadth 4 by 2.5 cm., height 1.3 cm.

*Cotypes.*—Three specimens, U.S.N.M. No. 49447, Puerto Escondido, March 26, 1940.

*Collecting records.*—Point Lobos, Espiritu Santo Island, March 20, 1940, 1 specimen; Angeles Bay, rocky coast, April 1, 1940, 3 specimens; south of Tiburón Island, April 3, 1940, 1 specimen.

*Remarks.*—The species is undoubtedly nearly related to *Bunodosoma* (*Eucladactis*) *grandis* (Verrill), to which I was at first inclined to refer the present specimens, but as *grandis* has smaller, very closely set, and more compound vesicles and very numerous tentacles (according to Verrill more than 500 in a large specimen) I think it is best to propose a new species for our specimens.

BUNODACTIS MEXICANA, new species

FIGURE 79, *a*

Pedal disc wide. Column, except for a short part of the limbus, provided with longitudinal rows of verrucae, which are more or less compound at the shallow fosse. Sphincter endodermal, pinnate-circumscribed. Tentacles up to more than 100, short, conical, hexamerously or irregularly arranged. Two distinct but not broad siphonoglyphs, symmetrically set or not, slightly prolonged aborally or not. Mesenteries regularly or irregularly arranged. Most of mesenteries perfect and apart from the directives fertile. Sterile mesenteries seemingly at the base. Retractors bandlike but

weak. Nematocysts of the columns 14–18.3 by 2.5–2.8  $\mu$  (basitrichs); those of the tentacles 15.5–22.6 by 2.2–2.5  $\mu$  (basitrichs); those of the actinopharynx partly 21–28 by about 3  $\mu$  (basitrichs), partly 19–22.6 by 4.5–5  $\mu$  (microbasic *p*-mastigophors); those of the filaments partly 19–33.8 by 5.6–6.3  $\mu$ , partly 11.3–16.2 by 2.8 (few, both basitrichs), partly 21–24 by 4.2–5  $\mu$  (microbasic *p*-mastigophors).

*Measurements*.—The largest specimen, height 1 cm., breadth 1.8 cm.

*Cotypes*.—Two specimens, U.S.N.M. No. 49451, San Carlos Bay, Sonora, Mexico, March 30, 1940.

*Remarks*.—The larger, fertile specimen provided with two siphonoglyphs, not symmetrically set, has 118 tentacles; the smaller, sterile specimen, about 96. I have drawn the sphincter of the sterile individual (fig. 79, *a*).

EPIACTIS IRREGULARIS, new species

FIGURE 79, *b*, *c*

Tentacles about 70. Sphincter restricted (diffuse circumscribed). Pairs of mesenteries 6 + 6 + 12 + 12, the mesenteries of the last cycle absent in the exocoels next to the mesenteries of the first cycle. Same number of mesenteries proximally and distally. Nematocysts of the columns partly 8.5–11 by 2.2  $\mu$ , common, partly 15.5–18.3 by 2.5  $\mu$ , common, a few 21–25 by 2.8  $\mu$  (all basitrichs); those of the tentacles partly 8.5–11.3 by about 2.2  $\mu$ , partly 18.2–26.8 by 2.8  $\mu$  (all basitrichs); those of the actinopharynx partly 21–26.8 by 3  $\mu$  (basitrichs), partly 19.7–21.8 by 4.2–5.5  $\mu$  (microbasic *p*-mastigophors); those of the filaments partly 11.3–18.3 by 2.2–2.8  $\mu$ , partly 38–43.7 by 3.5–4.2  $\mu$  (both basitrichs), partly 18.3–22.6 by 4.2–5.5  $\mu$  (microbasic *p*-mastigophors).

*Measurements*.—Length and breadth about 1.1 cm.

*Holotype*.—U.S.N.M. No. 49446, east of La Paz, March 21, 1940.

*Remarks*.—The sphincter (fig. 79, *b*) is almost restricted with the strongest folds distally. It has quite a different appearance from that of *Epiactis prolifera*, the sphincter of which seems to be fairly constant. I have examined the sphincter of two specimens of the latter species, one from Santa Cruz, provided with embryos on the column, and another from Puget Sound, and both agree in the main with that figured by Torrey (1902). The tentacles are of normal size and between 70 and 80 in number. The arrangement of the mesenteries in half of a specimen is 1 (directive), 3, 4, 2, 4, 3, 1, 3, 4, 2, 4, 3, 1, 3, 4, 2, 4, 3, 1 (directive). Twelve pairs of mesenteries are perfect. There are the same number of mesenteries proximally and distally. The retractors are restricted,

forming branched folds, which are stronger on the directives (fig. 79, *c*) than on the other mesenteries. The single specimen is sterile.

**PHIALOBA**, new genus

Pedal disc well developed. Column smooth, with very numerous basitrichs. Margin tentaculate. No sphincter. Tentacles conical, short, up to more than 400, most of them on the border of the lobed oral disc, their longitudinal muscles ectodermal. Two not deep siphonoglyphs, two pairs of directives. Numerous pairs of perfect fertile mesenteries, including the directives. Considerably more mesenteries at the margin than at the limbus. Retractors bandlike, diffuse. Cnidom: spirocysts, basitrichs, and microbasic *p*-mastigophors.



FIGURE 79.—*a*, *Bunodactis mexicana*, new species, sphincter. *b*, *c*, *Epiactis irregularis*, new species: *b*, Sphincter; *c*, retractor of directive. *d*, *Phialoba steinbecki*, new species, retractor of directive. *e-g*, *Phyllactis concinnata* (Drayton): *e*, Sphincter of specimen from Puerto Refugio; *f*, sphincter of specimen from Point Lobos; *g*, elongate sphincter. *h*, *Phyllactis bradleyi* (Verrill), sphincter.

**PHIALOBA STEINBECKI**, new species

FIGURE 79, *d*; PLATE 14, FIGURE 5

Column with extraordinarily numerous, closely set basitrichs. No sphincter. Tentacles hexamerously arranged, probably not retractile, or imperfectly so, most of them situated close to the margin. About 48 pairs of perfect and fertile mesenteries. Retractors of the perfect mesenteries rather bandlike with high, close,



somewhat branched folds. Parietobasilar muscles weak. Nematocysts of the column 11.3–39.5 by 2.2–3.5  $\mu$  (basitrichs, probably two kinds, the larger over 24  $\mu$  usually rare; in a specimen from Coronado Islands numerous); those of the tentacles 15.5–22.6 by 2.5–3  $\mu$  (basitrichs, common); those of the actinopharynx partly 12.7–26.8 by 2.2–3  $\mu$  (basitrichs, probably two kinds), partly 22.6–28 by 4.2–5.6  $\mu$  (microbasic *p*-mastigophors); those of the filaments partly 10–23.2 by 1.5–3.5 (basitrichs, probably two kinds), partly 19.7–26.8 by 4.2–5  $\mu$  (microbasic *p*-mastigophors).

Color in alcohol: The tentacles and oral disc of a specimen from Coronado Islands are green, two specimens from La Paz are brown, a fourth almost uncolored.

*Cotypes*.—Two specimens, U.S.N.M. No. 49459, east of La Paz, March 21–22, 1940.

*Additional distribution records*.—Coronado Islands, March 27, 1940, two specimens; Puerto Escondido, March 26, 1940, two specimens.

*Remarks*.—The pedal disc is well developed, but its diameter is considerably shorter than that of the oral disc. The basitrichs of the column are as closely set as the atrichs in the marginal spherules. Possibly they are arranged in groups. Most of the tentacles are so closely set at the margin that one could believe they are arranged as those of the so-called stichodactyline species. However, this is not the case. Plate 14, figure 5, shows the exterior of a specimen; figure 79, *d*, the retractor of a directive mesentery. The nematocysts have been examined in all specimens, and they agree. In a specimen with more than 400 tentacles there are 192 mesenteries at the base.

PHYLLACTIS CONCINNATA (Drayton)

FIGURE 79, *c-g*; PLATE 14, FIGURE 1

*Metridium concinnum* DRAYTON, in Dana, 1846, p. 152, pl. 5, figs. 40, 41.

*Oulactis concinnata* MILNE-EDWARDS, 1857, p. 292.—VERRILL, 1869, p. 463.—

ANDRES, 1883, p. 505.—VERRILL, 1907, p. 268 (footnote).

*Oulactis californica* McMURRICH, 1893, p. 196.

*Asteractis concinnata* PAX, 1912, p. 12.

The pedal disc is well developed, the body usually strongly contracted and then low (pl. 14, fig. 1). The upper part of the column below the fronds is provided with 40 to 48 longitudinal rows of verrucae to which sand may adhere. The fronds form a ruff, each one bearing a variable number of papillae. The uppermost fronds issuing from the first 12 endocoels project distally over the others. The sphincter varies considerably. It is diffuse, sometimes elongate, sometimes restricted; rarely it shows a tendency to be unilaterally circumscribed. In figure 79, *e*, I have drawn



the sphincter of a specimen from Puerto Refugio. It recalls the sphincter of *Anthostella* (*Phyllactis*) *conchilega* figured by McMurrich (1905) but on other slides not far from that figure the middle part, up to about a third of the sphincter, is attached to the column. The sphincter of the specimen from Point Lobos is more restricted (fig. 79, *f*); two others from Puerto Escondido and La Paz are more elongate (fig. 79, *g*). The tentacles number 40 or 48, conical, rather short, sometimes longitudinally sulcated in contracted state, their longitudinal muscles ectodermal, forming high folds that are closely set and sometimes a little branched. There usually are two rather broad siphonoglyphs that are symmetrically set and aborally more or less prolonged. The specimen from Puerto Refugio has, however, a single siphonoglyph. The pairs of mesenteries are 20 or 24, all perfect and fertile, including the directives; the specimen provided with a single siphonoglyph has 20 pairs. There are the same number of mesenteries proximally and distally. The retractors are diffuse, strong, especially below the actinopharynx. The parietobasilar muscles are well developed, forming a distinct shelf on the mesenteries. There are numerous zooxanthellae in the endoderm. The nematocysts of the column are 12.7–18.3 by 2.2–2.5  $\mu$  (basitrichs); those of the fronds 10–14 by 2.2–2.5  $\mu$  (basitrichs); those of the tentacles 21–33.8 by 2.5–2.8  $\mu$  (basitrichs, numerous); those of the actinopharynx partly 19.7–32.4 by 2.8–3 (3.5)  $\mu$  (basitrichs), partly 21–31.8 by 4–6.3  $\mu$  (microbasic *p*-mastigophors); those of the filaments partly 31–49.3 by 3–4.2  $\mu$ , partly about 10 by 2.5  $\mu$  (few, both basitrichs), partly 21–31.8 by 4.2–5.6  $\mu$  (microbasic *p*-mastigophors). Three specimens were examined, all agreeing in the size of the nematocysts.

*Color in alcohol.*—One specimen brown; another almost uncolored or pale brown.

*Measurements.*—The largest specimen, length of the column about 2.5 cm., breadth of the body up to 3.6 cm.

*Collecting records.*—Espíritu Santo Island, Point Lobos, March 20, 1940, 1 specimen; east of La Paz, March 21–22, 1940, 1 specimen; Puerto Escondido, March 26, 1940, 4 specimens; Puerto Refugio, Angel de la Guarda Island, April 2, 1940, 1 specimen.

#### PHYLLACTIS BRADLEYI (Verrill)

#### FIGURE 79, *h*; PLATE 14, FIGURE 2

*Asteractis bradleyi* VERRILL, 1869, p. 463; 1899a, p. 46, figs. 10–12.—ANDRES, 1883, p. 506.

The body of the larger specimen is very elongate (pl. 14, fig. 2); the smaller specimen is also longer than broad. The verrucae occupy only a small space below the ruff. In the large specimen

the papillae of the slightly developed fronds are scarce in some places, more numerous in others; in the smaller specimens they run out from more distinct fronds, which project as a fringe at the outer rim of the ruff (visible on the larger specimen, too). The 12 rows of fronds corresponding to the 12 primary tentacles are broader than the others and extended farther toward the tentacles than the other rows. The 24 narrow rows are the shortest. The sphincter is rather curious: in the part where the papillae of the fronds are scarce (see above) there is only a diffuse sphincter; in the part where they are numerous a unilateral, circumscribed, very fine and branched sphincter is present outside the diffuse sphincter (fig. 79, *h*). There are about 48 tentacles. They are conical and short, and their ectodermal, longitudinal muscles are not strong. There are two broad siphonoglyphs symmetrically set, and 24 pairs of mesenteries, 2 of which are directives. The retractors of the mesenteries are strong, bandlike, those of the directives more restricted. The parietobasilar muscles are strong, forming a distinct, thick shelf on the mesenteries. The nematocysts of the column are 15.5–19.7 by 2.5  $\mu$  (basitrichs); those of the fronds 11.3–14 by 2–2.5  $\mu$  (basitrichs); those of the tentacles 14–26.8 by about 2–2.5  $\mu$  (in the larger specimen 14–19  $\mu$ ) (basitrichs); those of the actinopharynx partly 21–31 by 2.8–3.5  $\mu$  (basitrichs), partly 22.6–27.5 by 4.5–6.3  $\mu$  (microbasic *p*-mastigophors); those of the filaments partly 25.4–46.5 by 2.8–3.5  $\mu$  (basitrichs), partly 21–28 by 5–5.6  $\mu$  (microbasic *p*-mastigophors).

*Color in alcohol.*—Pure white.

*Measurements.*—The larger specimen (pl. 14, fig. 2), length 5 cm., breadth 2.6 cm.

*Collecting records.*—El Mogote, sand flats, March 22, 1940, 2 specimens.

*Additional distribution record.*—Panama.

*Remarks.*—I have identified the specimens as *bradleyi*. A re-examination of *concinata* as well as of *bradleyi* is necessary, however, in order to confirm my identification of the species described here.

## Family AIPTASIOMORPHIDAE

### AIPTASIOMORPHA ELONGATA, new species

#### FIGURE 80, *a*; PLATE 14, FIGURE 8

Pedal disc ordinarily developed. Column smooth, thin, with visible insertions of the mesenteries (pl. 14, fig. 8). Cinclides, if present, not set on elevations. In contraction of the animal uppermost part of column drawn into the lower and forming a para-

pet. No distinct sphincter. Tentacles smooth, ordinarily long, numerous, up to about 192, hexamerously arranged. Two narrow siphonoglyphs. Six pairs of perfect mesenteries, two pairs of directives. Considerably more mesenteries at the margin than at the

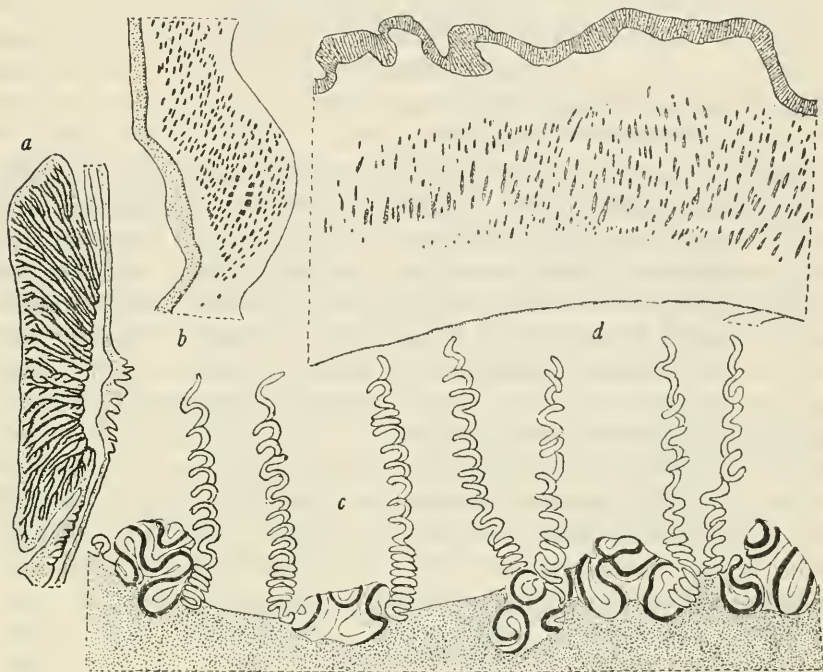


FIGURE 80.—*a*, *Aiptasiomorpha elongata*, new species, retractor. *b*, *c*, *Telmatactis panamensis* (Verrill): *b*, Upper part of sphincter; *c*, part of mesentery with pieces of discontinuous filament (black) and acontia. *d*, *Calliactis variegata* Verrill, lower part of sphincter.

limbus. Distribution of gonads unknown. Retractors bandlike (fig. 80, *a*). Perietobasilar muscles weak. Nematocysts of the column 13–17.6 by 4.2 (4.5)  $\mu$  (microbasic *p*-mastigophors); those of the tentacles partly 15.5–21 by 2.8–3  $\mu$  (basitrichs, few), partly 19.7–24 by 3.5–4.5  $\mu$  (microbasic *p*-mastigophors or amastigophors); those of the actinopharynx partly 21–26 by 2.8  $\mu$  (basitrichs), partly 24–29.6 by about 4.2  $\mu$  (probably microbasic *p*-mastigophors); those of the filaments partly 27.5–32.4 by 4.2–4.5  $\mu$  (probably microbasic *p*-mastigophors), partly 11.3–14 by 4.2–4.5  $\mu$  (microbasic *p*-mastigophors); those of the acontia partly 39.5–53.6 by 6.3–9.5  $\mu$  (probably microbasic *p*-mastigophors), partly 14–18.3 by 2.2–2.5  $\mu$  (basitrichs).

*Measurements*.—The largest specimen, length 3 cm., greatest breadth 1.8 cm.

*Holotype*.—San Carlos Bay, Sonora, Mexico, March 30, 1940.



*Collecting records.*—Point Lobos, Espíritu Santo Island, March 20, 1940, one specimen; Puerto Escondido, March 26, 1940, four specimens.

### Family ISOPHELLIIDAE

#### TELMATACTIS PANAMENSIS (Verrill)

##### FIGURE 80, *b*, *c*

*Phellia panamensis* VERRILL, 1869, p. 440.

*Phelliopsis panamensis* VERRILL, 1899c, p. 214.

Sphincter alveolar, very elongate, wholly separated from the endodermal muscles of the column (fig. 80, *b*). Tentacles up to 96 in number; in contraction usually longitudinally furrowed; in older specimens often somewhat knobbed, their longitudinal muscles ectodermal. Two siphonoglyphs. Up to 48 pairs of mesenteries, 2 pairs of directives, 6 pairs perfect with filaments and acontia and strongly restricted to almost circumscribed, often reniform, strong retractors. Other mesenteries without filaments, but the mesenteries of the second cycle, and sometimes those of the third, have filaments and acontia. Filaments of these mesenteries discontinuous with acontia, usually two, one on the upper side and one on the lower of each piece of the filaments (fig. 80, *c*). Number of mesenteries somewhat more numerous than the tentacles. Nematocysts of the tentacles (33.8) 39.5–42.3 by 2.5–2.8  $\mu$ , in the largest specimen 50.8–70.5 by 2.8  $\mu$  (basitrichs); those of the actinopharynx partly 22.6–31 by 2.8–3  $\mu$ , partly 12.7–18.3 by 1.5–2  $\mu$  (both basitrichs), partly (in the largest specimen) 25.4–32 by 4.2–5.5  $\mu$  (microbasic *p*-mastigophors ?); those of the filaments partly 12.7–22 by 1.5–2  $\mu$  (basitrichs), partly 11.3–19.7 by 3.5–4.2  $\mu$  (microbasic *p*-mastigophors) partly 38–60.6 by 8.5–11.3 (microbasic amastigophors); those of the acontia partly (42.3) 52.2–66.3 (in the largest specimen 62–73.3  $\mu$ ) by 8.5–12.7  $\mu$  (microbasic amastigophors), partly 21–25.4 by 2–2.5  $\mu$  (basitrichs). (The nematocysts of the largest specimens are usually longer than the smallest; the acontia have been examined in five specimens, the tentacles in three, the actinopharynx in two, and the filaments in four specimens.)

*Measurements.*—Of the largest specimen from Point Lobos, length 5.5 cm., greatest breadth 2 cm.; of the smallest specimen from Point Lobos, length 1.1 cm., breadth 0.5 cm.; of the largest specimen from Puerto Escondido, length 5 cm., breadth 2 cm.

*Collecting records.*—Point Lobos, Espíritu Santo Island, March 20, 1940, four specimens; Puerto Escondido, March 26, 1940, eight specimens; Coronado Island, two specimens; Puerto Refugio, April 2, 1940, one specimen.



*Additional distribution record.*—Panama.

*Remarks.*—The exterior is well described by Verrill. The arrangement of acontia in the mesenteries of the second (and third) order is apparently characteristic of the species. Figure 80, *c*, shows part of the mesentery with pieces of the discontinuous filament (black on the figure) and acontia. A very similar arrangement of the acontia is described by Panikkar (1936) in *Phyto-coetopsis ramunni* Panikkar. It is possible, however, that a similar distribution of the acontia occurs also in other species of *Telmatactis* but has been overlooked. In figure 80, *b*, I have illustrated the upper part of a sphincter of a medium-sized specimen. The sphincter shows a tendency to stratification and recalls the sphincter of a *Telmatactis* from the Great Barrier Reef. The youngest mesenteries seem to appear somewhat earlier than the corresponding tentacles. The largest specimen has only 78 tentacles, but 92 mesenteries; the mesenteries of the fourth cycle are absent on one side of a directive.

Verrill (1899c, p. 214) proposed a new genus, *Phelliopsis*, for his species, but Fischer (1887, p. 412) used this name for *Phellium nummus* Andres. However, the latter is not a *Telmatactis*. According to Verrill (1899c) the acontia are absent in *panamensis*, but I think he overlooked them.

### Family HORMATHIIDAE

#### CALLIACTIS VARIEGATA Verrill

##### FIGURE 80, *d*

*Calliactis variegata* VERRILL, 1869, p. 481.

The exterior of the species is well described by Verrill. The larger specimen is very flattened, almost cakelike. The sphincter is strong and distinctly transversely stratified. In its upper part it recalls rather strongly that of *Cricophorus nutrix* (Stuckey) inasmuch as the very elongate muscle meshes are separated from each other by mesogloea balks running parallel with each other. The lower part of the sphincter is illustrated in figure 80, *d*. The nematocysts of the tentacles are about 20.5 by 2–2.5  $\mu$  (basitrichs, very numerous); those of the actinopharynx 19.7–24 by 2.5–2.8  $\mu$ ; those of the filaments partly 10.6–12 by 1.5–2  $\mu$  (basitrichs), partly 19.5–23.3 by 4.2–5  $\mu$  (microbasic *p*-mastigophors); those of the acontia 19.7–24 by about 2.8  $\mu$  (basitrichs).

*Measurements.*—The larger specimen, breadth of pedal disc 3 by 3.5 cm.

*Collecting record.*—Concepción Bay, March 27, 1940, two specimens from a large conch housing a hermit crab.

*Additional distribution record.*—Panama.

*Remarks.*—Whether this species is identical with *C. decorata* (Drayton) from Honden Island is uncertain. According to Verrill, both species agree in color.

### Family METRIDIIDAE ?

#### ISOMETRIDIMUM, new genus

Metridiidae ? with broad base. Column divisible into a smooth, very thick scapus, wrinkled in contraction, and a thinner capitulum. No cinclides. Sphincter mesogloeal, situated in the uppermost part of the scapus and in the capitulum. Uppermost part of the capitulum and outer part of the oral disc drawn out to form very numerous, permanent lobes. At the apex of these lobes are extraordinarily numerous, short, filiform tentacles, all of about the same length, their longitudinal muscles ectodermal. Oral disc forming a wall inside the tentacles. Radial muscles well developed, ectodermal, present only on the inside of the lobes and on the outside of the wall; inner part of oral disc, however, without radial muscles. Two very broad siphonoglyphs. Mesenteries very numerous, several pairs perfect, two pairs of directives; the 12 first pairs sterile. Retractors of the mesenteries diffuse, not strong. Acontia numerous. Cnidom: spirocysts, basitrichs, microbasic *p*-mastigophors, microbasic amastigophors (and possibly microbasic *b*-mastigophors).

The position of this genus is doubtful because I cannot decide the type of the nematocysts of the acontia, especially whether there are basitrichs or *b*-mastigophors present. If the acontia have basitrichs, the genus may be referred to the family Sagartiidae, but in such a case *Isometridium* would be a very aberrant genus in that family. The thick column recalls that of many genera of the family Actinostolidae.

#### ISOMETRIDIMUM RICKETTSI, new species

FIGURE 81, *a*, *b*; PLATE 14, FIGURES 3, 4

Scapus up to almost 1 cm. thick in preserved state. Sphincter of the scapus transversely stratified, that of the capitulum forming a single row of muscle meshes. Tentacles very delicate, not arranged in distinct cycles. Oral disc inside the wall without radial muscles. The very broad siphonoglyphs provided with very large gonidial tubercles. Mesenteries very numerous; at least the stronger hexamerously arranged. Probably considerably more mesenteries distally than proximally. About 48 pairs of mesenteries perfect, the 12 oldest pairs sterile, the others perfect and the stronger imperfect fertile. Nematocysts of the capitulum partly 26.8–35.2 by 5–6.6  $\mu$  (basitrichs), partly 19.7–24 by 3.5–4.2  $\mu$  (microbasic

*p*-mastigophors or amastigophors); those of the tentacles partly 14.8–19 by 3–3.5  $\mu$ , partly 24.7–31 by 3.5–4.2  $\mu$  (often somewhat curved, microbasic *p*-mastigophors ?) those of the actinopharynx 23.3–31 by 2.8–4  $\mu$  (basitrichs); those of the filaments 11.3–18.3 by 4.2–6.3  $\mu$  (piriform, microbasic *p*-mastigophors); those of the acontia partly 46.5–55 by 5.6–6.3  $\mu$  (probably microbasic amastigophors), partly 26.8–32 by 2.8  $\mu$  (basitrichs or microbasic *b*-mastigophors). All nematocysts are unexploded and therefore the type of nematocyst is usually difficult to decide.

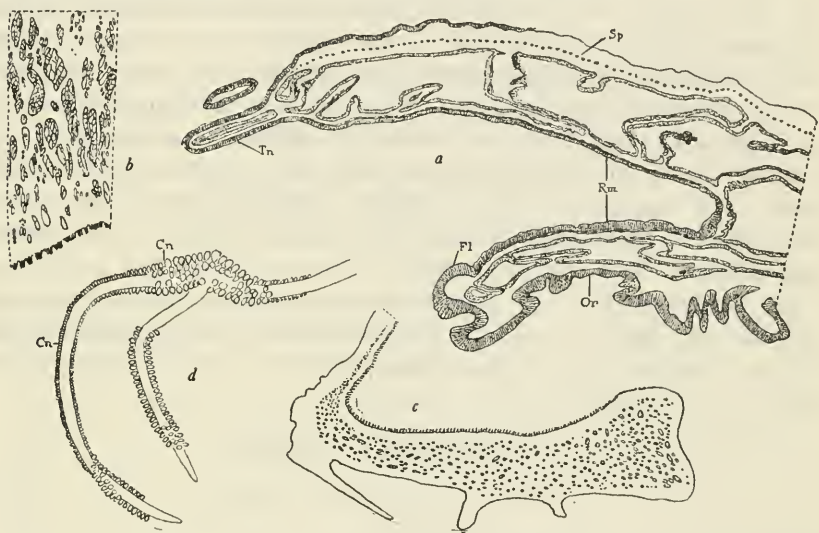


FIGURE 81.—*a*, *Isometridium rickettsi*, new species, longitudinal section of capitulum and fold (*Sp*, sphincter; *Tn*, tenacle; *Rm*, radial muscles; *Fl*, fold; *Or*, inner part of oral disc); *b*, *I. rickettsi*, part of sphincter in the scapus. *c*, *Anthothoe panamensis* (Verrill) ? sphincter. *d*, *Botruanthus benedeni* (Torrey and Kleeberger), cnidocytes (*Cn*) on a branched craspedoneme.

*Measurements*.—Diameter of pedal disc and height of the column 11 cm., corona up to 12 cm., length of tentacle 0.5–0.6 cm.

*Holotype*.—U.S.N.M. No. 49458, Guaymas, Mexico, April 9, 1940.

*Remarks*.—The appearance of this very interesting type (pl. 14, fig. 3) resembles that of *Metridium*, but its organization is quite different from that of this genus. The scapus is smooth but very wrinkled, probably owing to strong contraction. The part of the sphincter situated in the scapus is rather short, occupies at most about two-thirds of the thickness of the mesogloea, and is wholly separated from the endodermal muscles of the column. It is distinctly transversely stratified and the larger muscle meshes are divided into numerous smaller ones (fig. 81, *b*). It diminishes



quickly aborally; distally it runs over gradually into the muscle meshes of the capitulum, which are arranged in a single row (fig. 81, *a*). The lobes of the capitulum are very numerous, the tentacles thin and delicate and extraordinarily numerous, certainly more numerous than those of *Metridium*. They appear as a rim on the end of the lobes and their arrangement is impossible to determine, and it is even difficult to distinguish the directive tentacles from the others. The inside of the lobes and the outside of the fold are provided with well-developed ectodermal radial muscles (fig. 81, *a*). The inner part of the oral disc, which is devoid of radial muscles, is very wrinkled and broad, but narrow at the directives owing to the occurrence of very large gonidial tubercles. The very broad siphonoglyphs, symmetrically set, are prolonged almost to the base of the body. The retractors are diffuse, strongest in the innermost parts of the mesenteries and there forming palisadelike folds. The mesogloea of the filaments, especially that of the middle tract, is very thick in the region of the ciliated tract of the perfect mesenteries. The ova are small, the acontia thin but numerous. Plate 14, figure 4, shows a part of the oral disc with the tentacles and the fold, which is radially furrowed (at *x*) on its inside; figure 81, *a*, a longitudinal section of the capitulum and the fold; figure 81, *b*, part of sphincter in the scapus.

### Family SAGARTIIDAE

#### ANTHOTHOE PANAMENSIS (Verrill) ?

##### FIGURE 81, *c*

*Sagartia panamensis* VERRILL, 1869, p. 484.

Pedal disc wide, attached to *Turritella*-like snails. Column translucent showing the insertions of the mesenteries. The body forms a cone in contraction. Sphincter (fig. 81, *c*) alveolar, strong. Tentacles delicate, of moderate length, fewer than the mesenteries at the base. Two siphonoglyphs and two pairs of directives. Mesenteries of the first and second cycles perfect. Retractors diffuse, rather strong with high folds; the parietobasilar muscles well developed, forming a shelf on the weaker mesenteries. The weaker mesenteries of a sectioned individual are provided with ovaria, but the stronger are seemingly sterile and therefore the species may be an *Anthothoe*. The nematocysts of the column are partly 17–19.7 by 2.8–3.5  $\mu$  (basitrichs), partly 12.7–16.2 by 2.8–3.5  $\mu$  (probably microbasic *p*-mastigophors), both often somewhat curved; those of the tentacles partly 15.1–21.1 by 2.5–2.8  $\mu$  (basitrichs), partly 18.3–21.8 by 4.2  $\mu$  (often curved, microbasic *p*-mastigophors or amastigophors); those of the actinopharynx partly 19–25.4 by



2.8  $\mu$  (basitrichs), partly 19.7–25.4 by 4.2–5.5  $\mu$ , partly 10–19 by 4.2–6.3  $\mu$  (both microbasic *p*-mastigophors); those of the acontia partly 24–29.6 by 2.8  $\mu$  (basitrichs), partly 35.2–42.3 by 6–7  $\mu$  (microbasic amastigophors).

*Color in alcohol*.—Pale flesh-colored.

*Measurements*.—In contracted state, pedal disc about 1.7 cm., height of the column about 1.2 cm.

*Collecting record*.—Angeles Bay, April 1, 1940, two specimens on snails from sand flat.

*Additional distribution record*.—Panama.

*Remarks*.—I have doubtfully identified the specimens as *Anthothoë panamensis* because of the translucent column and the color.

## Order CERIANTHARIA

### Family BOTRUCNIDIFERIDAE

BOTRUANTHUS BENEDENI (Torrey and Kleeberger)

FIGURE 81, *d*

*Cerianthus benedeni* TORREY and KLEEGERGER, 1909, p. 121, figs. 2, 3.

*Botryanthus benedeni* McMURRICH, 1910, p. 11.

*Botruanthus benedeni* CARLGREN, 1912, pp. 42, 44–46.

Marginal tentacles up to about 100. Labial directive tentacle (*d*) present. Arrangement of the labial tentacles: 2(*d*)413.4312. 4312 —. Up to about eight mesenteries attached to the siphonoglyph. Hyposulcus and hemisulci rather well developed. Free parts of the directives not so long as the actinopharynx. Second protomesenteries long but not so long as the first metamesentery. Free part of the third protomesenteries about the same length as the actinopharynx. Most of the mesenteries *M* and *m* reach down almost to the aboral end of the body, metamesenteries *B* and *b* short. Ciliated tracts a little below the actinopharynx structured as the type 2. The ciliated tracts form a bunch of craspedonemes above the cnidoglandular tract of the third protomesenteries and the *b* and *B* mesenteries. The second protomesenteries and the *M* and *m* metamesenteries are provided with ciliated tracts almost their entire length. In the upper part of these mesenteries the ciliated tracts form bunches of craspedonemes; in the center the craspedonemes are scattered; and in the lowest parts more concentrated. Cnidorages of different size are collected in botrucnid-like bunches or as a pearl necklace on the craspedonemes of the ciliated tracts, either close to the apex of the craspedonemes or more inside. They are more numerous on the branched filaments than on the scattered ones. The second protomesenteries and the *M* and *m* metamesenteries are fertile, the other mesenteries sterile.

The nematocysts of the column are partly 43.7–63.4 by (9) 13–17  $\mu$ , partly 68.5–74.7 by 22.5–25.5  $\mu$  (both atrichs), partly 33.8–41 by 7–8.5  $\mu$  (type a, with a thick long shaft), partly 19.7–22.6 by 2.8–3  $\mu$  (type c, with very short shaft), partly 21–22.6 by 2.2–2.8  $\mu$  (with thin, long shaft; all three microbasic *b*-mastigophors); those of the marginal tentacles 25.4–28.2 by 4.2–5  $\mu$  (type b, shaft about half as long as the capsule; microbasic *b*-mastigophors); those of the labial tentacles partly 31 by 5.6–6.3  $\mu$  (atrichs, very rare), partly 31–39.5 by 7–8.5  $\mu$  (type a), partly 24–28.2 by 4.2–5  $\mu$  (type b), partly 16.2–21 by 2.8–3.5 (type c; all three microbasic *b*-mastigophors); those of the actinopharynx partly 28.2–36.7 by 5.6–7  $\mu$  (atrichs, few), partly (31) 35.2–42.3 by 6.3–8.5  $\mu$  (type a); partly 26.8–35.2 by 4.2–5.6  $\mu$  (type b), partly 18.3–24 by 4.5  $\mu$  (type c, all three microbasic *b*-mastigophors); those of the cnidoglandular tract partly 26–27 by 5–6.3  $\mu$  (type a), partly 14–19.7 by 2.8–2.5 (type c; both microbasic *b*-mastigophors); those of the craspedonemes of the ciliated tract 19.7–22.6 by 3.5–4.2  $\mu$  (type b, microbasic *b*-mastigophors); those of the larger cnidorages 66.3–73 by 14–18.3  $\mu$ , those of the smaller 53.6–60 by 12.7–15.5 (both microbasic *b*-mastigophors), moreover, a few *b*-mastigophors with thin long shaft about 22.6 by 4.2–5.6  $\mu$ . The column, marginal and labial tentacles, and the craspedonemes are provided with spirocysts.

*Color in alcohol.*—Column grayish brown, oral disc and labial tentacles red-brown, marginal tentacles almost uncolored, probably not banded.

*Measurements.*—The largest specimen in contracted state about 12 cm. in length, 2 cm. in greatest breadth.

*Collecting records.*—San Lucas Cove, south of Santa Rosalia, March 29, 1940, two specimens; Angeles Bay, April 1, 1940, one specimen; Estero de la Luna, Sonora, Mexico, April 10, 1940, one specimen.

*Additional distribution record.*—San Diego Bay, southern California.

*Remarks.*—The name *Botryanthus* proposed by McMurrich (1910) for the genus is probably a typographical error. In 1912 (pp. 44–46) I made a summary of the organization based on Torrey and Kleeberger's description of the species. In the present paper this description is completed. Figure 81, *d*, shows cnidorages (Cn) on a branched craspedoneme. The apex and the base of the branches are devoid of cnidorages, which are of very different size. Torrey and Kleeberger (1909) deny the supposition of von Beneden that the cnidorages are homologous with the acontia.

As to the position of the cnidorages and acontia, there are no distinct differences because the acontia sometimes occur in other places than at the end of the mesenteries.

### Family CERIANTHIDAE

#### PACHYCERIANTHUS INSIGNIS, new species

Marginal tentacles about 100. Directive labial tentacle (d) present. Arrangement of labial tentacles 2(d)413.4343. . . . About 8 mesenteries attached to the siphonoglyphs. Hyposulcus rather well developed. Free part of the directives somewhat shorter than the actinopharynx. Free part of the second protomesenteries (*p*2) somewhat more than double as long as the free part of the directives. Third protomesenteries (*p*3) somewhat shorter than *p*2. Several *M* and *m* metamesenteries reach down almost to the proximal end of the body but diminish, as usual, in length toward the multiplication chamber. *B* and *b*-metamesenteries rather short. Ciliated tract of the *M* and *m*-mesenteries distributed over almost their whole length with craspedonemes, which in the upper and lowest parts are more numerous than in the middle of the mesenteries. Craspedonemes of the ciliated tract on the *B* and *b*-metamesenteries absent?; *M* and *m*-mesenteries fertile; the other mesenteries sterile. Nematocysts of the column partly 43.9–64.9 by 12.7–20.4 (22.6)  $\mu$ , partly 42.3–49 by 7–10  $\mu$  (both atrichs), partly 48–56.4 by 11.3–14  $\mu$  (holotrichs, rare), partly (26.8) 31–43.7 by 5.6–7  $\mu$  (type a microbasic *b*-mastigophors with a long thick shaft), partly 25.4–29.6 by 3.5–4.5  $\mu$  (type c microbasic *b*-mastigophors with a short shaft); those of the marginal tentacles partly 24–35.2 by 5–5.6  $\mu$  (type a, very common), partly 19.7–24 by 3.5–4.2  $\mu$  (both microbasic *b*-mastigophors); those of the labial tentacles partly 31–43.7 by 5–8.5  $\mu$ , partly 22.6–28.2 by 3.4–4.2  $\mu$  (both microbasic *b*-mastigophors), partly 29.6–35.2 by 5.6–7  $\mu$  (atrichs, rather common); those of the actinopharynx partly 29.6–41 by 5–7  $\mu$  (atrichs), partly 22.8–42.3 by 5.6–8.5  $\mu$  (type a, rather common), partly 26.8–36.7 by 3.5–4.2  $\mu$  (scarce), partly 15.5–19.7 by 3.5–4.2  $\mu$  (type c; all three microbasic *b*-mastigophors); those of the cnidoglandular tract of the filaments partly 26.8–35.2 by 5.5–7  $\mu$  (atrichs, rather common), partly 22.6–32.4 by 6.3–8.5  $\mu$  (type a, very common), partly 13.4–19.7 by 6.3–8.5  $\mu$  (scarce, both microbasic *b*-mastigophors); those of the craspedonemes of the ciliated tract 28.2–42.3 by 5–5.6  $\mu$  (microbasic *b*-mastigophors, very numerous).

*Color in alcohol*.—Column grayish red-brown, marginal tentacles banded with stripes of red-brown, labial tentacles yellowish brown, actinopharynx yellowish.



*Measurements.*—In contracted state, length 12.5 cm., greatest breadth 1.5 cm.

*Holotype.*—U.S.N.M. No. 49454, El Mogote, sand flats, March 22, 1940.

*Remarks.*—Unfortunately my description of the species is incomplete, owing to the bad preservation of the upper part of the mesenteries. As far as I can see, the species is identical neither with *P. aestuarii* nor with *P. johnsoni*, both described by Torrey and Kleeberger (1909) from southern California.

## Order ZOANTHARIA

### Family EPIZOANTHIDAE

EPIZOANTHUS CALIFORNICUS, new species

FIGURE 82, *a-d*; PLATE 14, FIGURE 7

? *Epizoanthus elongatus* VERRILL, 1869, pp. 497, 565.

Coenenchyme thin and expanded. Polyps very unequal in size, usually cylindrical, closely set (pl. 14, fig. 7). Coenenchyme and scapus incrustated principally with sand to, at most, half their thickness, incrustations of the scapulus weaker. Ridges of the scapulus rather weak. Owing to the comparatively slight incrustation, the body wall feels rather weak. Sphincter strong with large meshes drawn out transversely. Siphonoglyph well developed, hyposulcus short. Mesenteries 34–38 in number. Numerous pigmented cells in the ectoderm of the column and in the endoderm of the mesenteries. Mesogloea of the column with numerous rounded cells; also pigmented cells here and there. Nematocysts of tentacles partly 12–16.9 by 2.8(3)  $\mu$  (microbasic *b*-mastigophors), partly 36.7–39.3 by 15.5–17  $\mu$  (holotrichs, probably belonging to the endoderm); those of the actinopharynx 15.5–19 by 3  $\mu$  (microbasic *b*-mastigophors); those of the filaments 14–17 by 4.2–5.5  $\mu$  (microbasic *p*-mastigophors); those of the endoderm of the mesenteries 38–42.3 by 14–17  $\mu$  (holotrichs).

*Color in alcohol.*—Brown.

*Measurements.*—Length of the polyps up to 0.9 cm., breadth 0.3–0.4 cm.

*Cotypes.*—A few colonies, U.S.N.M. No. 49456, La Paz, March 21–22, 1940.

*Additional distribution record.*—Near La Paz (Verrill, 1869, p. 565) ?.

*Remarks.*—The yellowish-brown pigmented cells are so numerous that they seem completely to fill the ectoderm. Figure 82, *c*, shows a section of the column; figure 82, *b*, a section of the inner part of the mesogloea of the column with large pigmented cells;



figure 82, *a*, a section of the sphincter. The mesogloea of the mesenteries contains very numerous cells, also cell-islets. The latter are sometimes prolonged and take the form of short canals, which, however, do not communicate with one another. In figure 82, *d*, I have drawn the lower part of a macromesentery showing cells and cell-islets. The number of mesenteries in five examined polyps (some of the largest) is 34 ( $18 + 16$ ), 36 ( $18 + 18$ ), 37 ( $18 + 19$ ), 38 ( $20 + 18$ ), 38 ( $20 + 18$ ). The tentacles of a sixth polyp is 36. The muscles of the mesenteries are weak.

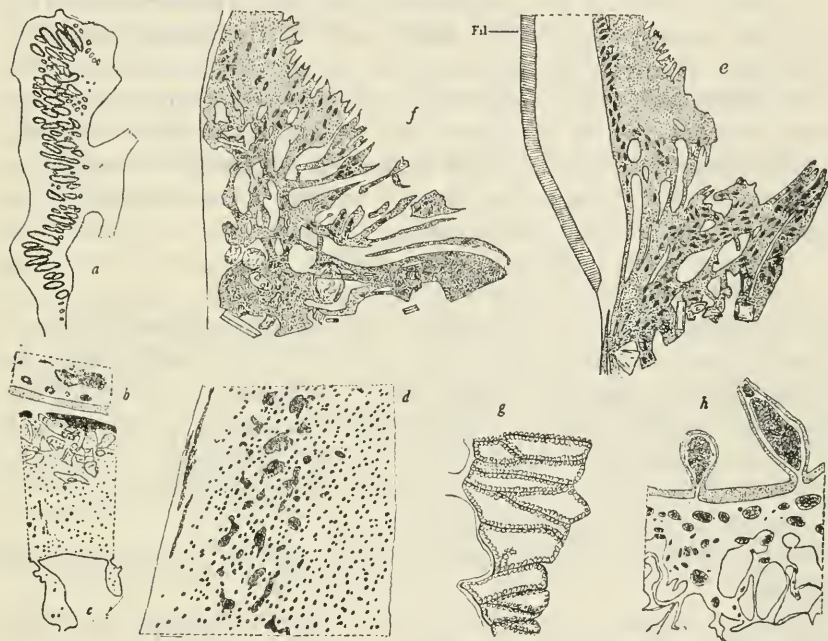


FIGURE 82.—*a-d*, *Epizoanthus californicus*, new species: *a*, Sphincter; *b*, section of inner part of mesogloea of column with large pigmented cells; *c*, section of column; *d*, lower part of macromesentery with cells and cell islets. *e*, *f*, *Palythoa complanata*, new species: Basal part of two macromesenteries with canal system and holotrichs (*Fil*, filament). *g*, *h*, *Palythoa praelonga*, new species: *g*, Sphincter; *h*, sectional column wall.

The species may be related to *Epizoanthus elongatus* Verrill from Peru and Pearl Islands. In fact, the short description of the exterior of Verrill's species agrees well with that given here of *E. californicus*, but, as Verrill notes that the mesenteries of a specimen were 42 and the tentacles 46 in another (therefore 46 mesenteries), it is rather difficult to identify his species with *californicus*, especially since Verrill says that each tentacle has a small tubercle outside of its base. Evidently only the uppermost part of the scapular ridges are sometimes tuberculated in *Epizoanthus*. In our species, the weak ridges do not show any pro-

jections. On the other hand, the specimen which Verrill with some doubt identified with *elongatus*, and which was collected near La Paz, is probably *californicus*. Besides, it is not certain that *elongatus* and the two other species of *Epizoanthus* described by Verrill (1869) belong to this genus, as Verrill synonymized *Gemmaria* (= *Palythoa*) with *Epizoanthus*.

EPIZOANTHUS GABRIELI, new species

PLATE 14, FIGURE 6

A small colony of five polyps (pl. 14, fig. 6) incrusting with grains of sand occupying the main part of the mesogloea, very closely set. Close to the endoderm there are very numerous cells in the mesogloea, which occur frequently in the mesogloea of the actinopharynx and in the outer part of the mesenteries as well. Coenenchyme flat, thin. Polyps elongate. Ridges of the scapulus distinct, heavily incrusting but hardly visible in contracted polyps. Sphincter mesogloea, strong, broad, transversely stratified. Siphonoglyphs well developed. Mesenteries in a larger specimen examined 30, of which 16 ( $8 + 8$ ) are macrocnemes. Nematocysts of the tentacles 14–19 by about  $2.8 \mu$  (microbasic *b*-mastigophors); those of the actinopharynx 15.5–19.7 by  $2.8$ – $3 \mu$  (microbasic *b*-mastigophors, common); those of the filaments 11.3–16.2 by  $2.8$ – $4.2 \mu$  (microbasic *p*-mastigophors), moreover a few 10–11 by  $3$ – $3.5 \mu$  (probably holotrichs, possibly belonging to the endoderm); those of the endoderm 38–43.7 by  $14$ – $15$  ( $18.3$ )  $\mu$ .

*Color in alcohol*.—Dark grayish.

*Measurements*.—Largest polyp, length 0.8 cm., breadth about 0.35 cm.

*Holotype*.—One colony, U.S.N.M. No. 49463, Gabriel Bay, Espíritu Santo Island, April 2, 1940.

Family ZOANTHIDAE

PALYTHOA COMPLANATA, new species

FIGURE 82, *e, f*; PLATE 14, FIGURE 9

Polyps scarcely projecting above the surface of the very thick coenenchyme, very closely set and of very different size, the smallest polyps occurring in the outermost part of the colony (pl. 14, fig. 9). Coenenchyme heavily incrusting with grains of sand. Ectoderm of the scapulus rather thin, without a cuticle. Ridges of the scapulus 18–21 (11 specimens examined). Mesogloea of the coenenchyme and column with cells and cell-islets. Sphincter forming a row of meshes. Tentacles small, with spirocysts. Siphonoglyph strong, hyposulcus long. Mesenteries up to more than 40. Branched pigmented cells and holotrichs in the

mesenterial canals. Figure 82, *e* and *f*, shows the basal parts of two macromesenteries with their canal system and holotrichs (the pigmented cells not figured, *f*-filament). Nematocysts of the tentacles 45–57.8 by 22.6–28.2  $\mu$  (holotrichs); those of the actinopharynx 24–29.6 by about 4.2  $\mu$  (microbasic *b*-mastigophors); those of the filaments partly 56–65 by 19.7–22.6  $\mu$  (holotrichs), partly (18.3) 21.1–24 by 4.2–5.6  $\mu$  (microbasic *p*-mastigophors), partly 37.4–47.9 by 5.6–6  $\mu$  (microbasic *b*-mastigophors); those of the mesenterial canals 52.2–63.5 by 22.6–25.4  $\mu$  (holotrichs).

*Color in alcohol*.—Brownish gray.

*Measurements*.—Larger polyps, breadth 0.9 cm., breadth of colony 5 by 6 cm.

*Holotype*.—One colony, U.S.N.M. No. 49455, Puerto Escondido, March 26, 1940.

*Remarks*.—A great area of rock and sponge was covered with these colonies.

PALYTHOA PRAELONGA, new species

FIGURE 82, *g*, *h*; PLATE 14, FIGURE 10

Solitary, extraordinarily elongate polyps, narrow in their lower part increasing in breadth toward the scapulus (pl. 14, fig. 10). About half to two-thirds of the mesogloea of the column incrustated with grains of lime. Mesogloea of the column with cells and cell-islets showing tendency to a ringlike arrangement toward the endoderm. Ridges of the scapulus about 32 or more, incrustated. Sphincter forming a row of very large, broad muscle meshes drawn out transversely (fig. 82, *g*, part of the sphincter). Tentacles with spirocysts. Siphonoglyph well developed, hyposulcus short. Mesenteries of the largest specimen about 72; without pigmented cells in their canal system, which probably does not contain any holotrichs in its lower part but has some in its upper (see fig. 82, *h*, which shows a section of the column in its upper part). Owing to the smallness of the mesenteries at the base, it is very difficult to determine if holotrichs are present; if so they may be very rare. Nematocysts of the column partly 19.7–33.8 by 5–5.6  $\mu$  (microbasic *p*-mastigophors, very rare), partly 18.3–21 by 3–3.5  $\mu$  (microbasic *b*-mastigophors); those of the tentacles partly 22.6–32.4 by 4.5–5  $\mu$  (few, microbasic *p*-mastigophors), partly 21.1–25.4 by about 3  $\mu$  (microbasic *b*-mastigophors), partly 48–49.3 by 21  $\mu$  (holotrichs—probably in endoderm); those of the actinopharynx 32.4–39.5 by 4.2–5  $\mu$  (microbasic *b*-mastigophors); those of the filaments partly 25.4–38 by 4.2–7  $\mu$  (microbasic *p*-mastigophors), partly 38.8–53.6 by 4.2–5.6  $\mu$  (microbasic *b*-mastigophors), partly 48–56.4 by 23.3–24  $\mu$  (holotrichs, rather scarce).



*Color*.—Yellowish gray.

*Measurements*.—Length 12.5 and 10 cm., respectively; breadth in their uppermost part 1.2 and 0.8 cm., respectively.

*Cotypes*.—Two specimens, U.S.N.M. No. 49445, Gabriel Bay, Espíritu Santo Island, April 12, 1940.

PALYTHOA RICKETTSI, new species

FIGURE 83, *a, b*; PLATE 14, FIGURE 11

Coenenchyme thin. Polyps robust, elongate, closely set (pl. 14, fig. 11) incrustated with grains of sand occupying the continuous ectoderm and the outermost part of the mesogloea only. Mesogloea of the column with cells and very numerous cell-islets often showing tendency to be arranged in an annulus toward the endoderm. (Figure 83, *a*, shows a transverse section of a part of the column). Ridges of the scapulus about 30–32 in larger specimens. Sphincter forming a row of rather broad meshes transversely set. Ectoderm of the column, tentacles, oral disc, and cell-islets provided with zooxanthellae. Tentacles seemingly without spirocysts. Siphonoglyph strong. Mesenteries in large specimens about 66. No holotrichs and no pigmented cells in the lower part of the mesenterial canals, but holotrichs are present although very rare in the upper part. Nematocysts of the tentacles partly 41–48 by 19.5–21 (24)  $\mu$  (holotrichs, few), partly about 28 by 2.8  $\mu$  (microbasic *b*-mastigophors, very rare); those of the actinopharynx 30–39.5 by 4.2–5  $\mu$  (microbasic *b*-mastigophors); those of the filaments partly 49.3–56 by 22–25.4  $\mu$  (holotrichs, few), partly 29.6–40 by 4.2–7  $\mu$  (microbasic *p*-mastigophors), partly 42.3–56.4 (60.5) and 3–3.5  $\mu$  (microbasic *b*-mastigophors).

*Color in alcohol*.—Gray with scattered black and yellowish grains of sand.

*Measurements*.—The largest polyp, contracted, is 2 cm. in length, 0.9 cm. in breadth at uppermost part.

*Types*.—Holotype, a small colony, U.S.N.M. No. 49440, south of Tiburón Island, April 3, 1940. Paratype, a small colony, U.S.N.M. No. 49441, same data.

PALYTHOA IGNOTA, new species

FIGURE 83, *c, d*; PLATE 14, FIGURE 12

Coenenchyme rather thin. Polyps more or less closely set (pl. 14, fig. 12) in contraction, somewhat longer than broad, robust, strongly incrustated with grains of sand penetrating almost the whole mesogloea of the column (fig. 83, *c*). Ectoderm of the column rather thin, mesogloea with cells but with few cell-islets. Ridges of the scapulus incrustated. Sphincter very elongate, of about same appearance as that of *P. ignota*. Cell-islets, ectoderm and



endoderm of the column, ectoderm of the tentacles with that of the actinopharynx without zooxanthellae. Tentacles with spirocysts. Siphonoglyph and hyposulcus strong. Mesenteries in large specimens about 50–58 (51 in a sectioned specimen; in the largest specimen there are 58 tentacles and therefore the same number of mesenteries). Micromesenteries well developed. No pigmented cells but numerous holotrichs in the mesenterial canals. Figure 83, *d*, shows a macromesentery seen from the side (inner side on the left). Nematocysts of the tentacles 21–31 by  $3.5\text{--}4\ \mu$  (microbasic *b*-mastigophors); those of the filaments partly 51–62 by  $19.7\text{--}21\ \mu$ , partly  $15.5\text{--}17.6$  by  $3.5\text{--}4\ \mu$  (both holotrichs), partly  $18.3\text{--}21.8$  by  $4.2\text{--}5.6\ \mu$  (microbasic *p*-mastigophors), partly  $49.3\text{--}65$  by about  $4\ \mu$  (microbasic *b*-mastigophors).

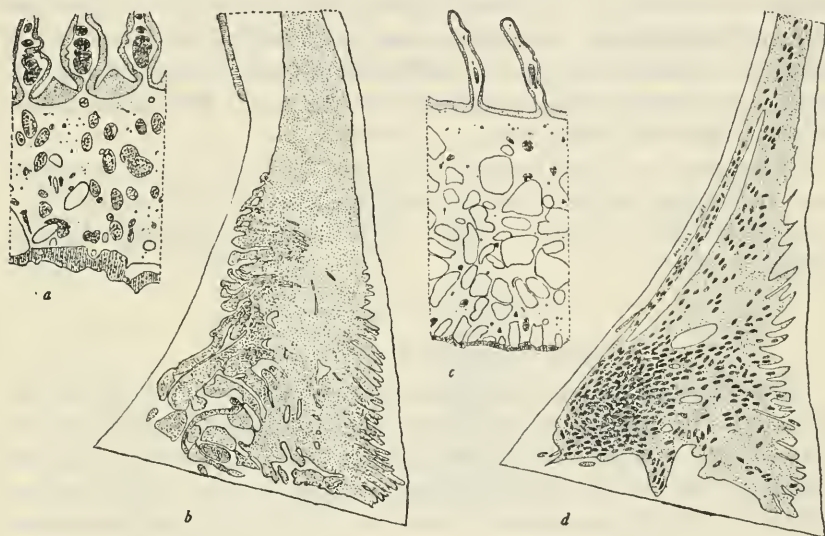


FIGURE 83.—*a, b*, *Palythoa rickettsi*, new species: *a*, Transverse section of column; *b*, macromesentery seen from the side. *c, d*, *Palythoa ignota*, new species: *c*, Section of column; *d*, macromesentery seen from the side (inner side to left).

*Color in alcohol*.—Grayish.

*Measurements*.—Larger polyps, contracted, 1.2 cm. in length, 0.7–0.9 cm. in breadth.

*Holotype*.—One colony, U.S.N.M. No. 49541, Angeles Bay, April 1, 1940, on rocks.

PALYTHOA INSIGNIS, new species

FIGURE 84, *a-c*; PLATE 14, FIGURE 13

Polyps somewhat elongate, of different size, connected with a rather thin coenenchyme (pl. 14, fig. 13). Ridges of the scapulus 24–32, incrustated. The ectoderm and the outer part of the mesogloea of the column incrustated with grains of sand. Mesogloea of

the column with cells and extraordinarily numerous cell islets (fig. 84, *a*). Sphincter strong, forming a single row of meshes (fig. 84, *b*). Tentacles with numerous spirocysts. Siphonoglyph well developed, hyposulcus strong. Mesenteries some up to more than 60. A sectioned specimen has 62 ( $32 + 30$ ) mesenteries, another about 60. Numerous pigmented cells and holotrichs in the mesenterial canals. Figure 84, *c*, shows a macromesentery in its lower part (inner side to the right, the pigmented cells are not figured). Ectoderm of the column, tentacles, and oral disc with zooxanthellae. Nematocysts of the column  $45\text{--}57.8$  by  $22.6\text{--}28.2\ \mu$  (holotrichs); those of the tentacles partly  $18.3\text{--}24$  by  $3\text{--}4.2\ \mu$  (microbasic *b*-mastigophors), partly  $46.5$  by  $21\ \mu$  (holotrichs, very rare); those of the actinopharynx  $25.4\text{--}39.5$  by  $3.5\text{--}4.2\ \mu$  (microbasic *b*-mastigophors); those of the filaments partly  $24\text{--}29.6$  by  $4.2\text{--}5.6$  (microbasic *p*-mastigophors, common), partly  $39.5\text{--}52.2$  by about  $4.2\ \mu$  (microbasic *b*-mastigophors), partly  $48\text{--}53.6$  by  $19.7\text{--}21\ \mu$  (holotrichs, very rare); those of the mesenterial canals  $50\text{--}52.2$  by  $19.7\text{--}22.6\ \mu$  (holotrichs, numerous).

*Measurements.*—The larger polyps are 1.5 and 1.3 cm., respectively, in length, and 0.7 and 0.8 cm., respectively in breadth.

*Cotypes.*—Two colonies, U.S.N.M. No. 49540, Coronado Island, March 27, 1940.

PALYTHOA PAZI, new species

FIGURE 84, *d*; PLATE 14, FIGURE 14

Polyps connected with a rather thin coenenchyme (fig. 84, *d*), incrustated with grains of sand occupying almost the whole mesogloea of the column. Mesogloea with rather numerous cells and cell-islets. Ridges of the scapulus distinct in the larger polyps and about 27–30 in number. Ectoderm of the column, tentacles, and oral disc with zooxanthellae. Tentacles with numerous spirocysts. Siphonoglyph strong. Mesenteries in large specimens up to about 60. Mesenterial canals with holotrichs and pigmented cells. In figure 84, *d*, the lower part of a macromesentery is reproduced, the pigmented cells are not figured (inner side on the left). Nematocysts of the actinopharynx  $24\text{--}33.8\ \mu$  (microbasic *b*-mastigophors); those of the filaments partly  $28.3\text{--}31$  by  $4.5\text{--}6.3\ \mu$  (microbasic *p*-mastigophors), partly  $35.2\text{--}50.8$  by  $4.5\text{--}5\ \mu$  (microbasic *b*-mastigophors), partly  $45\text{--}50.8$  by  $21\text{--}24\ \mu$  (holotrichs, very rare); those of the mesenterial canals  $49.3\text{--}55$  by  $19.7\text{--}22.5\ \mu$  (holotrichs).

*Measurements.*—Largest polyp, 1 cm. in length, 0.7 cm. in breadth; another polyp is 1.1 cm. in length, 0.6 cm. in breadth.

*Holotype.*—One colony, U.S.N.M. No. 49444, La Paz, on calcareous rocks, March 14, 1940.

## ZOANTHUS DANAЕ (LeConte) ?

FIGURE 84, c-h

*Zoantha danae* LECONTE, 1851, p. 320.

*Zoanthus danae* VERRILL, 1866, p. 329.—ANDRES, 1883, p. 539.

*Mamillifera danae* VERRILL, 1869, p. 496.

The polyps are rather thinly set and connected with a rather thin coenenchyme. The ectoderm of the scapulus is discontinuous but the mesogloea balks are very narrow. In the ectoderm of the column, numerous pigmented cells of varying appearance are collected. These are also present in the ectoderm of the tentacles and actinopharynx, in the mesogloea of the column, and in the endoderm. In figure 84, *e*, I have drawn some cells of the scapus. The canal system of the scapus at the level of the actinopharynx or just below it shows a rather closely set network, which in an individual from Puerto Escondido is somewhat thinner (fig. 84, *f*) than that of a specimen from Concepción Bay (fig. 84, *g*). The sphincters are strong, especially the lower sphincter, which is broad in its upper part but diminishes rather quickly downward. The muscle meshes

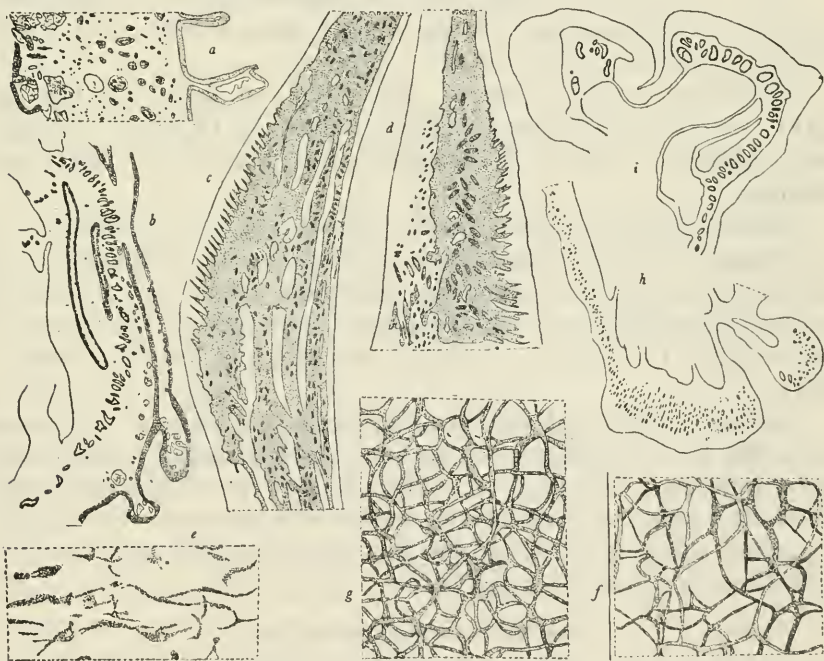


FIGURE 84.—*a-c*, *Palythoa insignis*, new species: *a*, Section of column; *b*, sphincter; *c*, lower part of macromesentery, inner side to right. *d*, *Palythoa pazi*, new species, lower part of macromesentery, inner side to left. *e-h*, *Zoanthus danae* (LeConte)?: *e*, Cells of scapus; *f*, canal system of scapus of specimen from Puerto Escondido; *g*, canal system of scapus of specimen from Concepción Bay; *h*, sphincter. *i*, *Zoanthus depressus*, new species, sphincter.



show a tendency to transverse stratification. I have sectioned sphincters of individuals from all localities; they agree rather well. In figure 84, *h*, I have drawn the sphincter of a specimen from Puerto Escondido; the muscle meshes are usually a little larger in other specimens. The tentacles are small, their spirocysts are few or almost absent. The siphonoglyph is indistinct. The mesenteries vary from 48 to 57 ( $26 + 32$ ;  $28 + 24$ ;  $28 + 26$ ;  $31 + 26$ ). They are thin, provided with a wide canal in the outer, swollen part; in their inner parts there are no canals or very few. Their muscles are distinct but form no pennons. The nematocysts of the scapus are 15–18.3 by 5.6–7  $\mu$  (holotrichs); those of the tentacles 13.4–18.3 by 5.6–7  $\mu$  (holotrichs); those of the actinopharynx partly 14–18 by 3.5–7  $\mu$  (holotrichs), partly 15–18.3 by 3–4  $\mu$  (microbasic *b*-mastigophors); those of the filaments partly 14–19.7 by 5.6–8.5  $\mu$  (holotrichs), partly 17–24 by 4.2–5.6–8.5  $\mu$  (holotrichs), partly 17–24 by 4.2–5.6  $\mu$ —in the specimens from Concepción Bay, narrower, 2.5–3.5  $\mu$  (microbasic *p*-mastigophors). Specimens from all localities were examined.

*Color*.—The living colony from Concepción Bay was blue-green.

*Measurements*.—Polyps in contracted state, length up to about 0.9 cm., breadth up to 0.4 cm.

*Collecting records*.—Puerto Escondido, on rocks, March 26, 1940, two colonies; Coronado Island, March 27, 1940, four colonies on fragments of lime; Concepción Bay, March 27, 1940, two colonies.

*Additional distribution records*.—Pearl Islands, Panama.

*Remarks*.—I have with some doubt identified the specimens with *Z. danae*, though the color of the specimens from Concepción Bay indicates that they may be referred at some time in the future to *Mamillifera* (= *Zoanthus*) *nitida*, described by Verrill (1869, p. 497).

I cannot understand Verrill's statement that there are 27 small tubercles inside the bases of the inner tentacles and opposite the outer tentacles. The species may be a *Zoanthus* as "the basal membrane and surface of the polyps are smooth and soft, without any adhering sand." Andres thinks that the tubercles are "brattee" but these do not occur in *Zoanthus*.

ZOANTHUS DEPRESSUS, new species

FIGURE 84, *i*

Owing to the very scant material available I can give only a very short description of this species, but it is certainly different from *Z. danae*. The small colony consists of a mother polyp and two



small daughter polyps, the one connected with the mother by a very thin coenenchyme, the other running out from the base of the mother. The body of the contracted polyps is very depressed so that they show a cakelike appearance. Both sphincters are well developed with rather coarse muscle meshes. Figure 84, *i*, shows the sphincters of one of the daughter polyps. The ectoderm of the tentacles is provided with very numerous spirocysts in contradistinction to that of the tentacles in *Z. danae*. The mesenteries of the large polyp are apparently about 46 in number.

*Measurements*.—Largest polyp in contracted state, 0.3 cm. in breadth, 0.1 cm. in height (depressed).

*Holotype*.—One colony, U.S.N.M. No. 49443, Cape San Lucas, March 18, 1940.

#### SOME ZOOGEOGRAPHICAL CONCLUSIONS

The upper littoral fauna of the Gulf of California and the waters down to Peru is a warm-water fauna containing, as far as the groups treated here are concerned, such genera as *Zoanthus*, *Palythoa*, and *Phyllactis*. These regions have several genera in common, but there are differences too. Three genera, *Calamactis*, *Phialoba*, and *Isometridium*, all new to science, are seemingly endemic in the Gulf of California. To these we may add *Botruanthus*, which, however, occurs in southern California not far from the border to Baja California. Moreover, the genera *Nemanthus*, *Alicia*, *Gyrostoma*, *Andvakia*, *Epiactis*, *Aiptasiomorpha*, and *Pachycerianthus* are seemingly absent in the waters between Panama and Peru. On the other hand, *Isarachnanthus*, *Bartholomea* (*Aiptasia* ?), and the dubious genera *Nemactis* and *Anactis* occur here but not in the Gulf of California. The genera that these waters have in common are *Phymactis*, *Anthopleura*, *Bunodosoma*, *Bunodactis*, *Phyllactis*, *Telmatactis*, *Anthothoë* (Verrill's *Sagartia* species are certainly *Anthothoë* or *Actinothoë* but not *Sagartia*), *Zoanthus*, *Epizoanthus*, and probably *Palythoa*, though it is difficult to decide if Verrill's *Epizoanthus* always is a homogenous genus.

Some authors have raised the question: Does there exist any relation between the fauna of the west side and that of the east side of Central America? How is this applied to the actinians? Unfortunately, the actinian fauna on the east coast of Mexico is unknown, but we know it on the northern coast of the Gulf of Mexico and, have still better knowledge of it from the West Indies, as this fauna has been studied by many authors. Thus, owing to

our incomplete knowledge of the actinians of the east side of Central America, the comparison given below is, of course, incomplete and defective.

The genera occurring in warm water in western America but not in the Gulf of Mexico or Caribbean Sea are *Calamactis*, *Phialoba*, *Isometridium*, *Nemanthus*, *Alicia*, *Epiactis*, *Phymactis* (provided *Cystiactis koellikeri* described from West Indian waters by Pax in 1910, p. 180, is not a *Phymactis*), *Gyrostoma* (the single small specimen from the West Indies described as a *Gyrostoma* by Pax (1910, p. 176) is very doubtful and probably a very young *Actinia* as Pax first suspected), *Aiptasiomorpha*, *Botruanthus*, *Isaracnanthus*, and *Pachycerianthus*.

The genera inhabiting the waters of the Gulf of Mexico and West India but not, so far as we know at present, the districts of Baja California to Peru are: All *Corallimorpharia*, *Edwardsia*, *Isoedwardsia*, *Bunodeopsis*, *Lebrunia*, *Actinia*, *Anemonia*, *Condylactis*, *Actinoporus*, *Stoichactis*, *Homostichanthus*, *Phymanthus*, *Isaurus*, and *Parazoanthus*.

The west and east sides of Central America have the following genera in common: *Anthopleura*, *Bunodosoma*, *Bunodactis*, *Phyllactis*, *Telmatactis*, *Anthothoë* (*Actinothoë*), *Zoanthus*, *Palythoa*, and *Epizoanthus*.

As we can see, there is a great difference between the actinian fauna on the west and east sides of Central America. That the *Corallimorpharia*, apart from the genus *Corynactis*, and the genera *Lebrunia*, *Actinoporus*, *Stoichactis*, *Homostichanthus*, *Phymanthus*, *Bunodeopsis*, and *Isaurus* which, as a rule, are inhabitant on coral reefs, do not occur on the west side is an easily explained fact, because reef-constituent corals, though occurring, do not form actual reefs there. It is curious, however, that there is no account of *Corynactis* on the west side, though species of it live in California and in Chile, but it is possible that the genus exists in the lower littoral zone. Moreover, it is very probable that *Edwardsia* appears on the west side, as the species of this genus are distributed in all oceans. The same probably is also true of *Isoedwardsia*. It is peculiar that *Actinia*, *Anemonia*, and *Condylactis*, which live in many other localities than on coral reefs, have not been discovered on the west side.

As to the genera that are common between the west and the east sides, *Anthopleura*, *Bunodactis*, *Telmatactis*, *Actinothoë* and *Anthothoë*, *Zoanthus*, *Palythoa*, and *Epizoanthus*, they are so widely distributed in warmer waters that we cannot conclude that the actinian fauna of these districts are nearly related to each

other. Only the occurrence of *Bunodosoma* and still more of *Phyllactis* indicates that a communication took place during earlier periods. The fact is that both *Bunodosoma* and *Phyllactis* have their principal distribution in the Atlantic Ocean. Besides, *Bunodosoma* occurs in the southwest part of the Indian Ocean and *Phyllactis* in the Red Sea. Species of the latter genus have been described also from Japan and New Zealand but they may probably be referred to another genus. It is remarkable that the actinian fauna of Baja California contains two genera, *Nemanthus* and *Gyrostoma*, which seem to be exclusively Pacific. *Nemanthus* occurs also off the coasts of Japan and the Bonin Islands. It seems, however, to live usually in the lower littoral zone, but is known from Misaki at a depth of 6 meters. *Gyrostoma* is common in the Indian and Pacific Oceans, but not with certainty reported from the Atlantic. The species taken in the West Indies is probably a young *Actinia* (see above), and the badly preserved specimens of *G. monodi*, from the coast of Cameroon, need a renewed examination.

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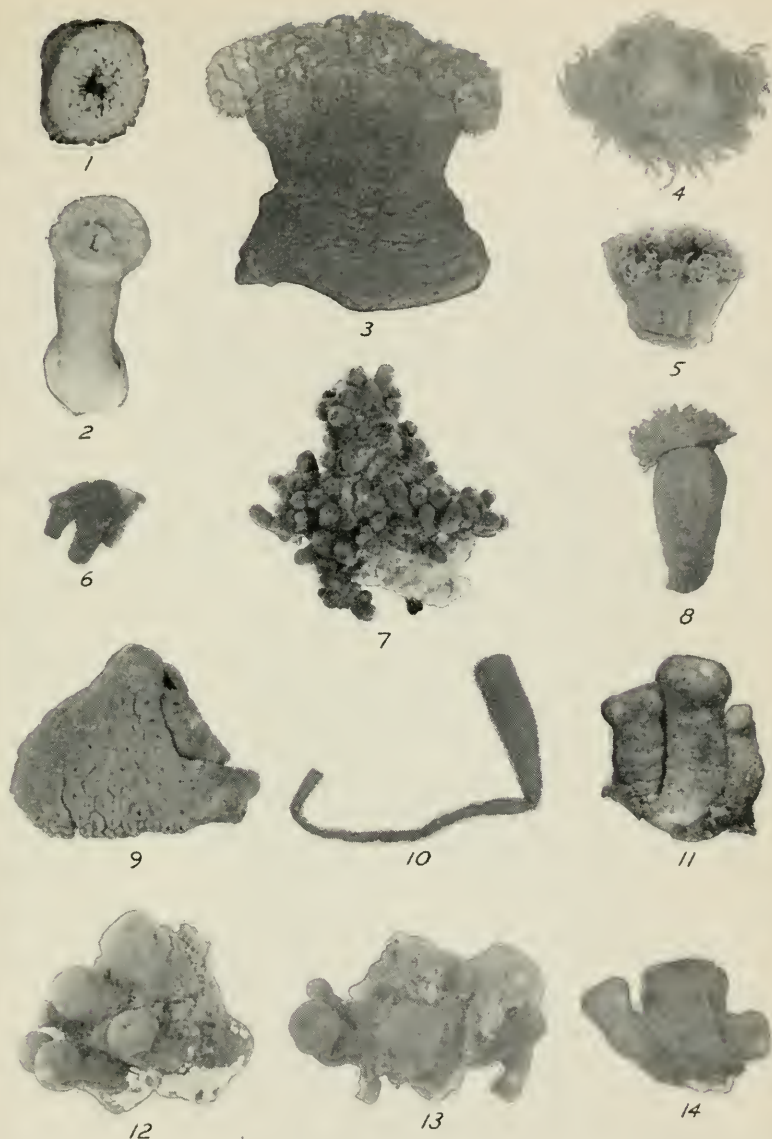
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## ACTINIAN FAUNA FROM THE GULF OF CALIFORNIA

- 1, *Phyllactis concinnata* (Drayton); 2, *Phyllactis bradleyi* (Verrill); 3, 4, *Isometriidium rickettsi*, new species; 5, *Phialoba steinbecki*, new species; 6, *Epizoanthus gabricli*, new species; 7, *Epizoanthus californicus*, new species; 8, *Aiptasiomorpha elongata*, new species; 9, *Palythoa complanta*, new species; 10, *Palythoa praelonga*, new species; 11, *Palythoa rickettsi*, new species; 12, *Palythoa ignota*, new species; 13, *Palythoa insignis*, new species; 14, *Palythoa pazi*, new species.



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NOTES ON CHRYSOMELID BEETLES OF THE SUBFAMILY  
CHLAMISINAE, WITH DESCRIPTIONS OF NEW SPECIES

By F. MONRÓS

AMONG some chrysomelid beetles of the subfamily Chlamisinae that I received for study from the United States National Museum are several of considerable interest, and these, together with notes on certain others of the same group received from other sources, form the subject of the present paper. I wish to express my thanks to Mrs. Doris H. Blake, who facilitated my borrowing material from the United States National Museum, and to the authorities of the National University of Tucumán, Argentina, for permission to publish the result of my researches.

One new species is added to the hitherto known forms of the genus *Melittochlamys*. The status of the known species of this genus is set forth in the key.

KEY TO THE SPECIES OF MELITTOCHLAMYS MONRÓS, 1948

1. Smooth and shining dorsally, without any tubercles or irregularities; uniform and shining metallic bluish green; shape of *Lamprosoma* (Guiana; northern Brazil)..... **lamprosomoides** (Lacordaire)  
More or less irregular dorsally; sometimes with black, velvety, well-defined spots on elytra; unlike *Lamprosoma*..... 2
2. Each elytron with 3 well-defined, depressed, velvety black spots; elytral surface rugose; dark cupreous-gray, moderately shining; antennae and legs yellowish brown (Brazil; Paraguay)..... **specula** (Klug)  
Elytra without velvety spots or with only one spot each..... 3
3. Pronotum, on each side of posterior lobe with a small triangular area, smooth and metallic shining; rest of surface of body cupreous, not shining; antennae reddish, tarsi yellowish brown; small subglobose species with moderately developed rugosities (Brazil)..... **semen** (Lacordaire)  
Whole pronotal surface of same nature, without brilliant areas at basal lobe. 4

4. Each elytron with a well-defined black velvety spot, which occupies a more or less depressed area..... 5  
Elytra without well-defined velvety spots; sometimes with colors that change when viewed from different angles..... 8
5. Dorsally slaty blue; head, antennae, and legs yellowish; each elytron with an elliptical basal velvety black spot; suture apparently without teeth (teeth visible only on open elytra) (Mexico)..... **pavonina** (Lacordaire)  
Dorsally grayish, not or very little shining and darker than in preceding species..... 6
6. Discal area of elytra with deep fovealike punctures; each elytron with an anterior elliptical velvety area; underside and legs (except tarsi, which are yellow), black (southern Brazil)..... **achardi** Monrós  
Discal punctures of elytra not deeper than elsewhere; deeper punctures appear only in velvety spots..... 7
7. Elytral suture with small teeth; legs black, tarsi yellowish (Brazil).  
**sericans** (Lacordaire)  
Elytral suture without teeth; legs yellowish brown..... **exsula** Monrós
8. Underside, head, and legs ferrugineous; thorax slaty gray, opaque; basal half of elytra blackish, apical half bluish and shining (Panama) (no specimens seen)..... **godmani** (Jacoby)  
Ventrally and dorsally of same color; legs and head sometimes yellowish.... 9
9. Suture toothed. Head slaty gray like rest of body; antennae and legs orange-yellow. Each elytron near suture and in middle of its length with a short and feeble shining transverse ridge (Brazil)..... **nicki** Monrós  
Suture without teeth..... 10
10. Head unicolorous, cupreous greenish, like rest of body; antennae and tarsi yellowish brown (Brazil, Mexico?)..... **hydropica** (Lacordaire)  
Head bicolorous; ventral half yellow; rest of body obscure..... 11
11. Legs entirely yellow; rest of body unicolor slaty bluish, moderately shining (Mexico)..... **amoena** (Lacordaire)  
Only the tarsi orange-yellow. Rest of body leaden gray with moderate violaceous sheen at sides. Elytra without shining transverse ridge (Costa Rica)..... **freyi**, new species

**MELITTOCHLAMYS FREYI, new species**

FIGURE 85, b

Very similar to *M. nicki* Monrós, 1948, from which it may be distinguished by having tibiae and femora of the same color as the rest of the body, by having the ventral half of the head dark brown, and by having different elytral sculpture.

*Pronotum*.—Of semicircular form when seen from above, with its basal margin prolonged in a long posterior lobe, the top of which is not incised; regularly convex and without a central area that is distinctly separated from the laterals; seen from the side, the notal profile regularly arched; pronotal surface finely shagreened and with a few small circular superficial punctures, denser in the posterior lobe.

*Scutellum*.—Rectangular, its angles rounded, plain, and finely shagreened.

*Elytra*.—Apparent margins scarcely narrowed toward the apex, where they are broadly rounded; suture without teeth; the whole surface shagreened and with elongated punctures; scarcely developed

rugosities that are difficult to describe, all of similar height, may be seen over the whole surface.

*Head*.—Anterior and somewhat inferior; its surface plain and shagreened with large but not deep punctures in the clypeal region; antennae short and compact, distinctly saw-edged from the fourth joint.

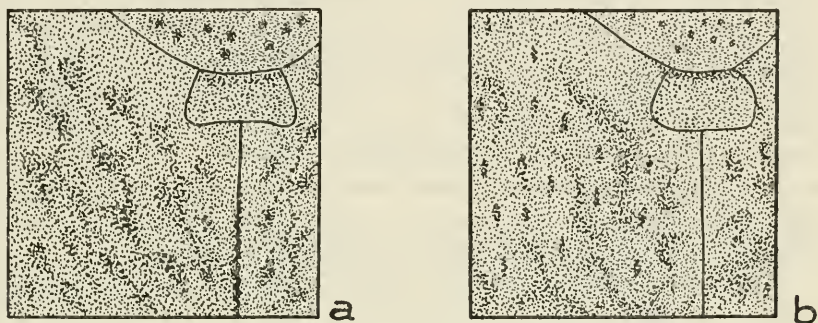


FIGURE 85.—Microsculpture of basal part of elytra in: *a*, *Melittochlamys nicki* Monrós; *b*, *M. freyi*, new species.

*Prosternum*.—Rectangular, relatively broad, its posterior margin nearly straight and the anterior margin with a transverse impression; rest of the inferior face and legs as in *M. nicki*. Pygidium moderately convex, shagreened, and covered with punctures, which are larger on the dorsal and more closely placed on the ventral half.

*Color*.—Lead gray, moderately shining; antennae (darker toward the apex), labrum, interocular space, ocular incisions, and tarsi orange-brown; viewed from certain angles, the pronotal and elytral margins appearing with a broad and moderately shining obscure violaceous reflection.

*Measurements*.—Holotype, female, length 3.2 mm., breadth 2.3 mm.

*Type*.—In the collection of G. Frey, Munich.

*Distribution of material*.—Turrialba, Costa Rica, 1 holotype, female, G. Frey collection.

*Relationships*.—This species may be distinguished from *M. nicki* by the above characters. From *M. semen*, with which it is closely allied in general shape and reduced length, it may be separated by the absence of the two metallic pronotal areas found in that species.

Named in honor of G. Frey, of Munich, who kindly sent me his Chlamisinae for study.

#### The CHLAMISUS HISPIDULUS group

Lacordaire, in reviewing the subfamily Chlamisinae, placed *C. spinosus* (Kollar), *C. hirtus* (Kollar), and *C. hispidulus* (Klug) in the

same group, which he distinguished by the presence of high, raised, conical, dorsal tubercles and the cupreous metallic color. In a footnote in the same revision, the author<sup>1</sup> indicates the differences in the form of the antennae and tarsi of the three species, which he states are so closely allied otherwise that these differences must not be taken into account in the grouping of the *Chlamisus* species.

However, study of the three above-mentioned species shows that they are only apparently related to each other. I believe, for example, that *C. hirtus* is worthy of a separate genus or subgenus based on the following characters: The pubescent dorsal surface; the form of the tarsal claws; and the shape of the male genitalia, which are different from those found in any other species of *Chlamisus*. The form of the male genitalia of *spinus* is also very peculiar and not like that of any other species of the genus, and this seems sufficient reason to exclude that species also from relationship with *hispidulus*.

*Chlamisus hispidulus*, with its allied forms that are dealt with in this paper, approaches *C. gibbosus*, the genotype as designated by Jacoby,<sup>2</sup> and other North American species of Lacordaire's eleventh group. These species may be considered to belong to the typical group, although there must be a reduction in the heterogeneous species that now make up the genus.

*Chlamisus hispidulus* presents a number of closely allied forms that may be separated by the key. The systematic range of all these forms is not always clear, and some of them are perhaps no more than subspecies of different geographic distribution. Except for *C. hispidulus llajtamaucanus*, for which subspecific relationship can be established, it has seemed better to consider them all as different species, at least for the present.

#### KEY TO THE SPECIES OF THE CHLAMISUS HISPIDULUS GROUP

1. Pygidium shagreened; its surface subopaque, not more shining than rest of abdomen; pronotal and elytral tubercles obtuse; in former it is not possible to distinguish four conical spines; elytral tubercles more or less united and ridge-shaped, not like independent cones; length 3.8 mm., 2.6 mm. (southern Bolivia)-----*simillimus* Monrós
- Pygidium smooth, with some superficial punctures, more shining than rest of abdomen----- 2
2. Pronotum with a broad median groove, on both sides of which there are two conical tubercles, more or less pointed but always very distinct----- 3
- On each side of median pronotal groove an elongated raised area, top of which is surmounted by a continuous edge somewhat depressed in its middle; elytral tubercles moderately developed; more elongate shaped than in the following species; length 4 mm., breadth 3 mm. (central and western Argentina)-----*hispidulus llajtamaucanus*, new subspecies

<sup>1</sup> Lacordaire, Monographie des Coleoptères \* \* \*, Phytophages, vol. 2, p. 697, 1848.

<sup>2</sup> Fauna of British India: Coleoptera, Chrysomelidae, vol. 2, p. 271, 1903.



3. Large (more than 5 mm. in length); pronotal tubercles conical and very acute, distinctly separated from each other; elytral tubercles also well developed (central Brazil)-----*erinaceus*, new species  
Not so large (approximately 4 mm. in length), tubercles less developed.. 4
4. Longitudinal pronotal groove with fine longitudinal striae, between which a few punctures can be seen with difficulty; elytral surface also with fine and dense striae with indistinct punctures between them (central, northern, and eastern Argentina; Montevideo)-----*hispidulus hispidulus* (Klug)  
Longitudinal pronotal groove with deep and close punctures, between which there are some longitudinal fine striae; elytral punctures very distinct; elytral surface shagreened, only the tubercles and irregularities covered with fine striae (interior of Brazil)-----*insolitus*, new species

## CHLAMISUS SIMILLIMUS Monrós

*Chlamisus simillimus* MONRÓS, Acta Zool. Lilloana, vol. 6, p. 179, 1948.

This species is easy to identify because of its pygidium, which is of a different sculpture from that of all other species of this group. Only the holotype from Bolivia is known.

## CHLAMISUS HISPIDULUS (Klug)!

This species was described from Montevideo, and it is the only one of the genus so far known from Argentina, where it seems to be rather common and of wide distribution. The material studied enables me to separate it into two subspecies:

## CHLAMISUS HISPIDULUS HISPIDULUS (Klug)

*Chlamys hispidula* KLUG, Entomologische Monographien, p. 86, 1824.—LACORDAIRE, Monographie des Coleoptères \* \* \* Phytophages, vol. 2, p. 700, 1848.—BURMEISTER, Stett. Ent. Zeit., vol. 38, p. 61, 1877.

*Chlamys cordovensis* JACOBY, Proc. Zool. Soc. London, 1907, p. 158, pl. 14, fig. 7.

This subspecies is well described in Klug's, Lacordaire's, and Jacoby's works, and it does not seem necessary to repeat the description. The identity of Klug's and Jacoby's species is evident.

*C. hispidulus hispidulus* occurs in two colors: cupreous, most commonly, and metallic reddish (somewhat similar to some dull specimens of *Fulcidax cupreus* or *F. violaceus*); apparently more frequent in the northern part of the general area.

This subspecies inhabits the greater part of central and northern Argentina from Baradero in the south (examples cited by Burmeister) to Jujuy and Misiones in the north. Toward the west it may be found in Córdoba, where it intergrades with the other subspecies, which inhabits dry areas.

## CHLAMISUS HISPIDULUS LLAJTAMAUCANUS, new subspecies

This subspecies replaces *C. hispidulus hispidulus* in the dry parts of the western general area of the species, and the specimens that may be considered as more typical *llajtamaucanus* (corresponding to those from La Rioja and Santiago del Estero) could easily be regarded as

specifically different from *C. hispidulus*. However, there are other specimens (principally from Córdoba) in which the differences are less marked and which point to a merely geographical differentiation. I describe here the maximum difference from *C. hispidulus hispidulus*, as observed in specimens from Santiago del Estero.

Microsculpture formed by a fine shagreen with the striolae that are very distinct in *C. hispidulus hispidulus*, scarcely visible; color as in that subspecies, sometimes with more evident greenish metallic shining; on both sides of the median pronotal groove an elongated divergent raised area, surmounted by an obtuse edge, which is depressed in its middle. Each elytron moderately developed and not connected each with the other, with the following irregularities: A humeral callus and two basal tubercles, of which the external one is more developed; a small sutural tubercle near the scutellum; six tubercles arranged in two parallel oblique lines, three in each line, of which the sutural anterior is large and transverse and represents the highest elytral irregularity; three others on the external apical declivity arranged to form a triangle and but little developed.

*Measurements*.—Female, length 4.6 mm., breadth 3.2 mm.; very small male, length 3.6 mm., breadth 2.4 mm.

*Type*.—In the collection of F. Monrós, Tucumán, Argentina; paratype U.S.N.M. No. 59904.

*Distribution of material and specimens examined*.—Argentina: Llajta Mauca, Santiago del Estero, January 1944 (holotype in the Monrós collection, Tucumán); Rio Salado (1 paratype in the Bosq collection, Buenos Aires, Wagner collector; 1 paratype in the U. S. National Museum, Monrós collector); Añatuya, January 1944 (1 paratype in the Monrós collection, Tucumán); La Rioja (1 paratype in the Breyer collection, Museo Argentino de Ciencias Naturales, Buenos Aires); Mendoza (1 paratype in the Bruch collection, Museo Argentino de Ciencias Naturales, Buenos Aires); Córdoba (1 paratype in the Museo de Buenos Aires; 1 paratype in the Berg collection, Museo de La Plata; 1 paratype in the Narodni Museum, Prague, Staudinger collector; 1 paratype, same collection, Davis collector; 5 paratypes in the collection of the Deutsches Entomologisches Institut, Berlin, Stempelmann collector, identified as "*C. hispidulus* Klug"), Monte Cristo, December 1944 (2 paratypes in the Monrós collection, Tucumán).

*Remarks*.—An examination of the male genitalia reveals the complete identity of this subspecies with the *C. hispidulus* group.

CHLAMISUS INSOLITUS, new species

FIGURE 86

Similar to a small specimen of *C. hispidulus hispidulus* with well-developed tubercles; a little shorter and more compact than *C. hispi-*

*dulus*, of brighter color and with a somewhat yellowish golden metallic sheen; elytral and pronotal tubercles like those of that species, but more raised; general morphological characters identical with those of *C. hispidulus hispidulus*.

The principal differences may be seen in the microsculpture of the dorsal surface: median pronotal groove covered with coarse and deep, somewhat elliptical punctures, which also appear on the external margin of the raised tubercles and toward the posterior angles, the whole surface with fine striolae like those of *C. hispidulus*, but not so distinct; elytral punctures deeper and larger than in *C. hispidulus* and the surface very finely shagreened; only the tubercles and irregularities with striolae, which converge toward their vertices.

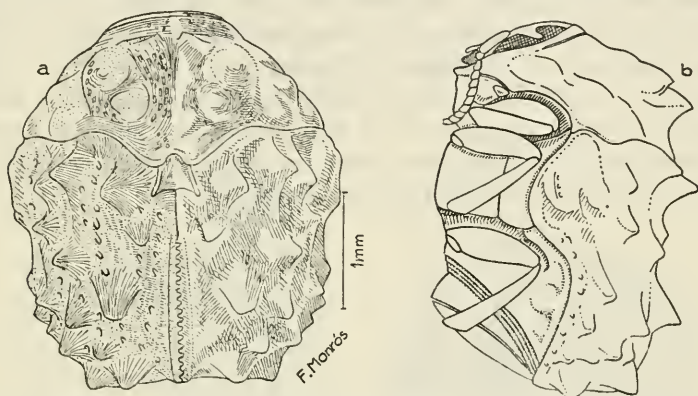


FIGURE 86.—*Chlamisus insolitus*, new species: *a*, Dorsal view, left side, showing microsculpture of the surface; right side, showing the irregularities of the body; *b*, lateral aspect.

*Measurements*.—Length 3.4 mm., breadth 2.5 mm.

*Type*.—U.S.N.M. No. 59905.

*Distribution of material*.—Rio Madeira, Porto Velho, Brazil. 1 holotype, male, Mann and Baker collectors, Mann collection in the U. S. National Museum, identified as "*Chlamys hispidula* Klug, F. C. Bowditch det. 1913."

*Remarks*.—I consider this species different from *C. hispidulus*, to which it is undoubtedly closely allied, principally because of the pronotal punctures and the elytral microsculpture. I have not seen a single specimen of *C. hispidulus* with this kind of deep and coarse punctation in the median groove.

#### CHLAMISUS ERINACEUS, new species

FIGURE 87

Large and with well-developed tubercles, somewhat like *C. spinosus*, its color like that of *C. hispidulus*, from which its morphological characters differ as follows: On each side of the median groove the



pronotum presents two conical and acutely raised tubercles, separated from each other; pronotal lateral callus developed into a short and obtuse tubercle; number and disposition of the elytral tubercles like that of *C. hispidulus*, but tubercles higher and more acute; some of them resemble small spines; first abdominal segment laterally with two tubercles more acute than the corresponding ones in *C. hispidulus hispidulus*.

*Measurements*.—Length 5.0 mm., diameter 3.8 mm.

*Type*.—In the collection of the Zoological Museum, Copenhagen, Denmark.

*Distribution of material*.—Brazil: Lagoa Santa (1 holotype female, Reinhardt collector, in the collection of the Zoological Museum, Copenhagen, identified as "*hispidula* Klug"); Rio de Janeiro (1 paratype female, Kraatz collector, in Deutsches Entomologisches Institut, Berlin, identified as "*Chlamys* sp., Bryant det.").

*Remarks*.—The present very peculiar species resembles an extraordinarily developed example of *C. hispidulus*, but since I have not seen forms transitional between these species, I prefer to consider it a separate entity, at least for the time being.

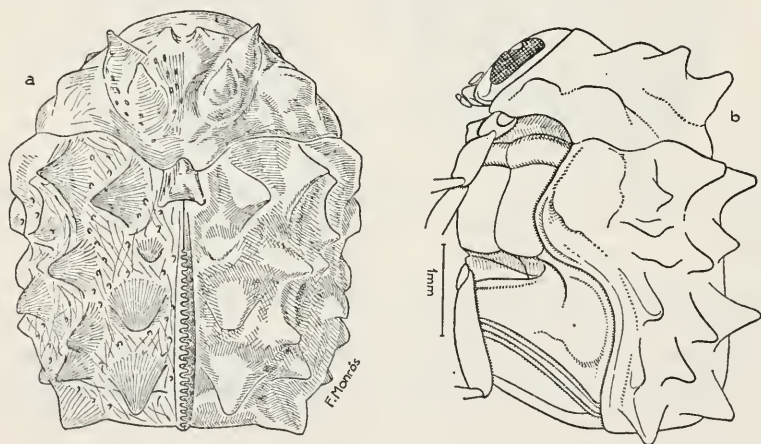


FIGURE 87.—*Chlamisus erinaceus*, new species: *a*, Dorsal view, left side, showing micro-sculpture of the surface; right side, showing the irregularities of the body; *b*, lateral aspect.

The United States National Museum collections contain the following new members of the Chlamisinac:

CHLAMISUS ROGAGUANUS, new species

FIGURE 88

A minute species, belonging to Lacordaire's eighteenth group, of nearly uniform toast-yellow color and without well-developed differential characters.



*Pronotum*.—Of triangular shape, viewed from above, with its vertex broadly rounded; central raised area hemispherical, with a longitudinal low and broad groove, limited on both sides by an almost indistinct ridge; seen from this side the notal profile nearly semicircular, with its most elevated portion somewhat corroded; its surface covered with relatively deep circular punctures, deeper and more confluent in the raised central portion so that the surface seems to be somewhat corroded.

*Scutellum*.—Minute, somewhat concave, shagreened.

*Elytra*.—Narrower than the abdomen, which is partly visible laterally; basal margin with minute teeth, the sutural margin feebly toothed in the posterior half and without teeth in the anterior half; elytral surface covered with fine, confused, circular punctures and with the ridges which are peculiar to this group of species arranged as shown in figure 88, *a*, and feebly developed.

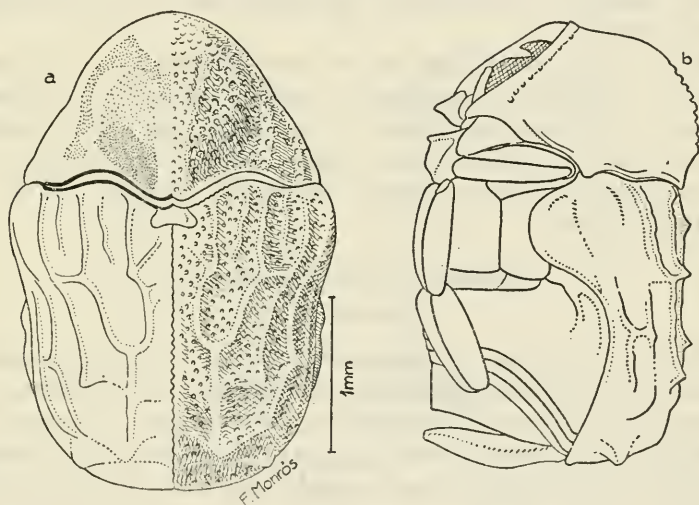


FIGURE 88.—*Chlamisus rogaguanus*, new species: *a*, Dorsal view, left side, indicating color pattern, right side, showing microsculpture and irregularities; *b*, lateral aspect.

*Head*.—Plain, covered with large but feebly impressed punctures uniformly dense over the whole surface; antennae with second and third joints short and opposite each other, distinctly saw-edged from the fourth joint.

*Prosternum*.—Rectangularly transverse on the anterior half, with a laminar prolongation in the posterior half; anterior margin somewhat concave.

*Legs*.—Moderately long and slender; the last tarsal joint raised one-half above the lobes of the third.

*Abdomen*.—Sides of the first visible segment without lateral tubercle; pygidium feebly convex, superficially corroded and with traces of a

median longitudinal ridge, which is not continuous in its whole length.

*Color*.—Bright toast-yellowish, darker on the dorsal face; head with a minute and ill-defined black interocular spot; middle of the ventral part of metathorax and abdomen black; posterior femora with a dark median ring on the middle; posterior margin of pronotum and anterior margin of elytra and scutellum with a narrow black margin; pronotum on each side of the central raised area with a basal brownish red oblong spot and another of the same color but brighter on the top of the same; central raised area somewhat darker than the rest of the pronotum; posterior half of the longitudinal groove of the same toast yellow as the elytra and scutellum.

*Measurements*.—Length 3.6 mm.; breadth 2.4 mm.

*Type*.—U.S.N.M. No. 59906.

*Distribution of material*.—Rosario Lake, Rogagua, Bolivia, October 28 to November 9, 1922 (holotype male, W. M. Mann collector, Mulford Biological Expedition, 1921–1922, in the U. S. National Museum collection).

*Remarks*.—This small species has few peculiarities. It may be related to *C. cribricollis*, from which it can be separated by its smaller size and the different punctation of the pronotum. It corresponds to a group of very similar small species, mostly undescribed, which seem to inhabit southern Brazil, Paraguay, eastern Bolivia, and northern Argentina.

CHLAMISUS CRIBRICOLLIS, new species

FIGURE 89

Of the same group as *C. rogaguanus*, recognizable by the circular, very uniform, and moderately dense punctures of its pronotum, which tend to form regular rows in the median posterior part of the pronotum.

*Pronotum*.—Seen from above its shape is triangular, broadly rounded at the apex; central raised area hemispherical, scarcely grooved longitudinally in the middle; seen from the side the notal profile stoutly conical, very little corroded on the top; the whole pronotal surface covered with small circular punctures, all of a uniform size and separated from each other by distances equal to their diameters; in the middle of the pronotum, these punctures with a tendency to form longitudinal rows, four or five of which are distinct.

*Scutellum*.—Flat and smooth.

*Elytra*.—Somewhat narrower than the abdomen, the sides of which are partly visible posteriorly; basal margin finely toothed on its internal half; the sutural margin toothed on the posterior two-thirds; in the example at hand the suture not closing perfectly behind the scutellum and a long and narrow triangular portion of the metanotum visible between the elytra. Elytral irregularities feebly developed, arranged as is common in this group of species and indicated in figure

89, *a*. Between the elytral irregularities, small and superficial circular punctures, which are more distinct because of their dark bottom, the punctures not confluent in any part of the elytral surface.

*Head*.—Flat, covered with large and superficial punctures, which are more apparent on the posterior half; antenna with second and third joints minute and opposed at the apex; distinctly saw-edged from the fourth joint.

*Prosternum*.—Funnel shaped, with a transversal constriction behind the anterior margin.

*Legs*.—Moderately long and robust; the last tarsal joint rises half its length above the lobes of the third.

*Abdomen*.—Sides of the first visible segment without lateral tubercle; pygidium feebly convex, the surface flat and uniformly covered with circular punctures of the same form as those covering the rest of the abdomen; in the holotype female the abdomen greatly distended and the genital apparatus partly visible.

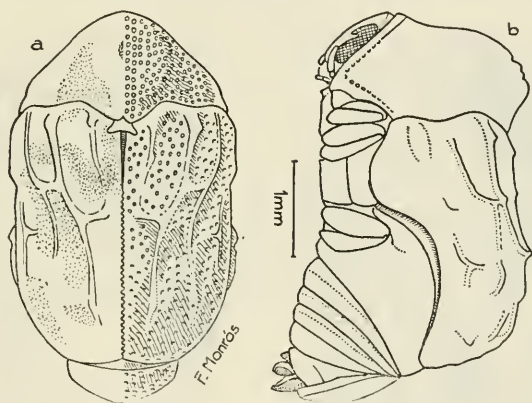


FIGURE 89.—*Chlamisus cribricollis*, new species: *a*, Dorsal view, left side, indicating color pattern; right side, showing microsculpture and irregularities; *b*, lateral aspect.

*Color*.—Dirty yellow with the median part of the metathorax black; all the tibiae with an ill-defined dark ring occupying the central third; in the center of the pronotum a black punctiform spot; rest of the dorsal face with ill-defined dirty-brown spots, arranged approximately as indicated in figure 89, *a*, and extending over the greater part of the dorsal face.

*Measurements*.—Length, 4.1 mm.; diameter, 2.5 mm.

*Type*.—U.S.N.M. No. 59007.

*Distribution of material*.—Río Beni, Cavinas, Bolivia, February 1922 (1 holotype female, William M. Mann collector, Mulford Biological Expedition, 1921–1922, in the U. S. National Museum collection).



*Remarks.*—This species may be separated from all its allies in Lacordaire's eighteenth group by the very uniform pronotal punctures, which show a tendency to form longitudinal rows on the posterior central part of the pronotum. The little pronotal black spot and the distribution of the dorsal coloration may help in its identification.

CHLAMISUS YAGUAR, new species

FIGURE 90

A small species belonging to the same group as *C. rogaguanus* and *C. cribricollis*; yellow with many well-defined black spots.

*Pronotum.*—Seen from above, of triangular shape with the apex broadly rounded; central area hemispherical, not grooved longitudinally and somewhat corroded, owing to the presence of small but deep confluent punctures, which do not occur on some irregular small raised vermicular areas; seen from the side, the notal profile semicircular, somewhat flattened on top.

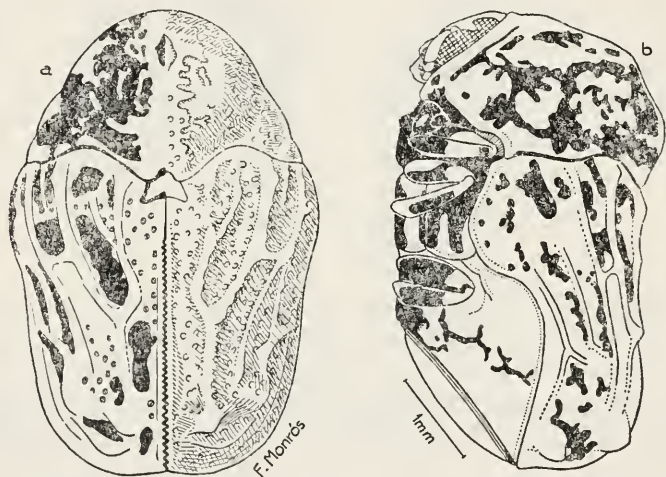


FIGURE 90.—*Chlamisus yaguar*, new species, holotype: *a*, Dorsal view, left side, indicating color pattern; right side, showing microsculpture and irregularities; *b*, lateral aspect.

*Scutellum.*—Flat and smooth.

*Elytra.*—Somewhat narrower than the abdomen, the sides of which are partly visible posteriorly; basal margin feebly toothed; the sutural margin toothed in the posterior four-fifths; each elytron with the usual irregularities of this group, arranged as may be seen in figure 90; between the ridges small nonconfluent circular punctures.

*Head.*—Flat, covered with large but not very deep punctures, uniformly dense over the whole surface; antennae moderately long, the second and third joints short and opposite to each other; distinctly saw-edged from the fourth joint.



*Prosternum*.—Anterior half of pentagonal shape, prolonged posteriorly into a narrow ridge between the coxae.

*Legs*.—Moderately long and robust; the last tarsal joint rising one-third its length above the lobes of the third.

*Abdomen*.—Sides of the first visible segment without lateral tubercle; pygidium somewhat elongated and also corroded, with a complete feeble median longitudinal ridge.

*Color*.—Holotype: cinnamon-yellow, with irregular black spots arranged approximately as follows: Central part of metathorax and abdomen four small pygidial spots; a broad femoral ring on all legs; tibial spots occupying the apical third on all legs; a small spot on the base of each antenna; pronotum and elytra with irregular spots, arranged as may be seen in figure 90 and not symmetrical on both sides of the body. Paratype: a rusty orange and the black spots (especially those on the pronotum) much reduced.

*Measurements*.—Holotype length 3.4 mm., breadth 2.3 mm.; paratype length 3.5 mm., breadth 2.3 mm.

*Type*.—In the collection of the Deutsches Entomologisches Institut, Berlin; paratype in the U. S. National Museum, U.S.N.M. No. 59908.

*Distribution of material*.—Paraguay: San Bernardino (1 holotype, Fiebrig collector, in the collection of the Deutsches Entomologisches Institut, Berlin); Sapucay, February (1 paratype, T. E. Foster collector, in the U. S. National Museum collection).

*Remarks*.—This species belongs to Lacordaire's eighteenth group and may be recognized easily by its peculiar coloration taken in conjunction with the prosternal shape.











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NOTES ON A HERPETOLOGICAL COLLECTION FROM  
OAXACA AND OTHER LOCALITIES IN MEXICO

By FREDERICK A. SHANNON

DURING the summer of 1946, Walter S. Miller, of the Summer Institute of Linguistics, Mexico City, made a herpetological collection in the vicinity of San Lucas Camotlán, Oaxaca, where he was engaged in making a philological study of the Mixes Indians. The collection would be to the credit of a professional herpetologist, for not only is it well labeled as to time, date, and place, but it contains careful notes on habits, color in life, habitat, and other pertinent data. Notes on this material constitute the bulk of this paper, which is a Contribution from the University of Illinois Museum of Natural History. In addition, other miscellaneous specimens that have come to my attention during this study and material that represents helpful contributions to the study of Mexican herpetology have been included. Most of the specimens are in the collection of the United States National Museum.

Quotations without label are Mr. Miller's. In the main they are unaltered, but I have made occasional slight changes that better express the meaning of Mr. Miller's original field notes.

My sincere thanks are due Dr. Hobart M. Smith and W. Leslie Burger, both of the University of Illinois—to Dr. Smith for many helpful suggestions made during the course of this study, and to Mr. Burger for identifying the *Bothrops*, a discussion of which is published elsewhere. My thanks are also due my wife, Ellen Jordan Shannon, who illustrated the paper. I also thank Dr. Doris M. Cochran, of the United States National Museum staff, through whom arrangements

were made for the University of Illinois to retain one of the two paratypes of *Hyla milleri* described in this paper, and for permission to study the material.

### Genus AMBYSTOMA Tschudi

#### AMBYSTOMA ROSACEUM NIGRUM, new subspecies

#### FIGURE 91

*Holotype*.—U.S.N.M. No. 123581, larva; collected by Ralph G. Miller on an indeterminate date.

*Type locality*.—El Salto, Durango.

*Diagnosis*.—A large neotenic salamander characterized by a black ground color with yellow markings; by the presence of black ventral bands; by a short leg (toes of extended leg do not closely approach adpressed elbow); and by a pedal phalangeal formula of 2-2-3-3-2.

*Description*.—Dorsal fin originating on back (23 mm. from snout), at same level as point of origin of anterior limbs; fin elevated 3.5 mm. at level of hind limbs, and 4.5 mm. at base of tail; gill rakers on middle arch 22 in number. Vomerine teeth in curved patches separated by a distance less than a third their lengths, about 33 in number and as many as 4 in a transverse row; 34 maxillary-premaxillary teeth; 48-52 splenial teeth, arranged in two rows posteriorly; 10 pterygoid teeth; 11 costal grooves not counting slight auxiliary grooves over axilla and groin; phalangeal formula of hand 2-2-3-2, of foot 2-2-3-3-2; webbing not reaching distal ends of metacarpals or metatarsals (i. e., base of digits includes terminal portions of metacarpals); at least 5-mm. space between adpressed leg and elbow.

The light ground color of Taylor's (1941) specimens of *rosaceum* is so largely replaced by black markings that an actual reversal of color pattern is apparent, *nigrum* showing a black ground color with yellow (in alcohol) markings. The top of the head is black with indistinct light reticulations; yellow on body limited to indistinct longitudinal bands, which tend to break up into spots; tail mottled with widely separated, irregularly shaped light blotches; caudal fins translucent and heavily mottled with black; limbs yellow-mottled; belly yellow, marked by two long, wide lateral bands of black which are separated from black of sides by broken lateroventral yellow bands.

*Measurements of holotype in millimeters*.—Total length 110; body length 59; tail length 51; length of snout 5; eye width 3; snout to arm insertion 19.

*Remarks*.—Although no intergradation area has been demonstrated between *nigrum* and the more northern *rosaceum*, *nigrum* is here interpreted as being of subspecific rank. The pattern type is essentially

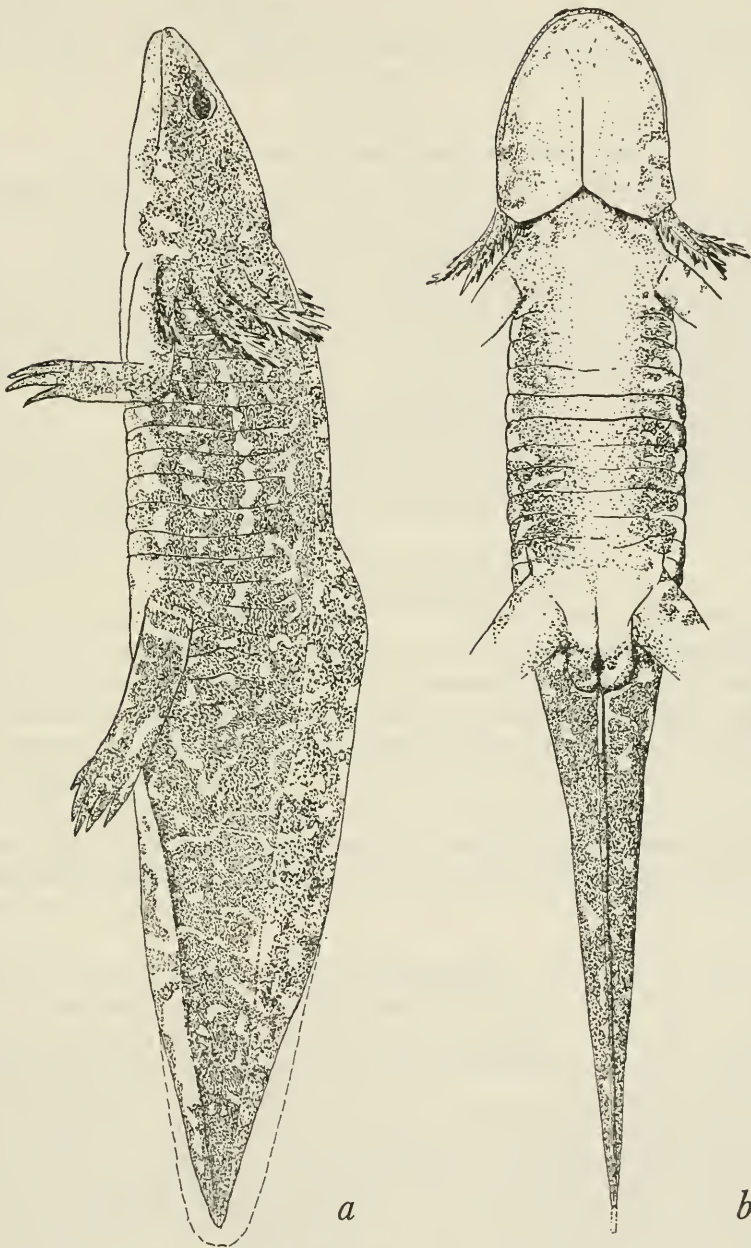


FIGURE 91.—*Ambystoma rosaceum nigrum*, new subspecies, holotype,  $\times 1.5$ .

the same in both, except for the above-mentioned reversal. Other differentiating characters found in *nigrum* but not in *rosaceum* are ventral black bands, shorter hind leg (reaches elbow in *rosaceum*), and a different phalangeal formula (2-2-3-4-2 in *rosaceum*) on the foot. The last may not be of taxonomic significance, as variants in phalangeal formulae do occur occasionally.

AMBYSTOMA ROSACEUM SONORAENSIS, new subspecies

*Types*.—Holotype: U.S.N.M. No. 17253, larva; P. L. Jouy collector.

Paratypes: U.S.N.M. Nos. 17254-17256, topotypic larvae.

*Type locality*.—Sonora, 32 miles south of the Arizona border.

*Diagnosis*.—Maximum known total length 102 mm. (larva); color chocolate-brown (in alcohol) with irregularly shaped small yellowish blotches, which tend to form longitudinal bands; belly uniformly pale; toes failing to reach elbow by 6 mm. when limbs are adpressed; web involving only metacarpals and metatarsals.

*Description*.—Head width (12 mm.) contained in body length about 4.5 times; diameter of eye 2.5 mm.; gill rakers 20 on middle arch; gills partially absorbed; tail fin (largely absorbed) originating well posterior to insertion of hind legs; 10 and possibly 11 moderately developed costal folds. Maxillary-premaxillary teeth about 33 on a side; pterygoid teeth about 10-10; vomerine teeth about 30-30 (?); splenial teeth in more than one row and about 50-50 in number.

Limbs well developed; metacarpals and metatarsals not quite fully webbed; phalangeal formula of hand, 2-2-3-2, of foot, 2-2-3-4-2.

*Color*.—Dark brown "ground color" extends to edge of, but not or barely onto, venter; tail fin remnant colored same as body. Otherwise pattern similar to that of *A. r. nigrum* (fig. 91).

*Measurements of holotype in millimeters*.—Total length 102; body length 55; tail length 47; length of snout 4.5; interorbital 5; internasal 5; diameter of eye 2.5; distance between choanae 5; snout to arm insertion 19.0.

*Remarks*.—Paratype U.S.N.M. No. 17254 is similarly colored except that the light lateral band is more distinct, being continuous for the length of the body. The other two paratypes are too small (40 mm.) and too poorly preserved to be of much diagnostic use. It is apparent, however, that they are not so heavily pigmented as the holotype, the dark and light colors occupying equally extensive areas. The larger paratype is about equal in total length to the types of Taylor's (1941) *rosaceum* (87 and 85 mm.) but is almost as heavily pigmented as the holotype of *sonoraensis*. Thus it is apparent that the diagnostic differences in coloration between *r. rosaceum* and *r. sonoraensis* are not age differences. *A. r. sonoraensis* is easily differentiated from *nigrum* by occurrence in the latter of ventral black bands. The lesser phalangeal



formula of *nigrum* will be of doubtful significance until further specimens come to light.

Absorption of the major portion of the branchial rays and of the tail fin presents the probability that these salamanders metamorphose in this region.

The three subspecies of *Ambystoma rosaceum* are physiographically well differentiated. *A. r. rosaceum* is found in the Apachian biotic province (Smith, 1939) in the easternmost hills of the Sierra Madre Occidental near the Plateau. The northern Mexican portion of the Sierra Madre is divided into two longitudinal sections by a central lowland drainage. Whereas *r. rosaceum* occurs in the easternmost portion of the eastern division, *r. sonoraensis* occurs in the western portion of the western division, which is located in the Arizonan biotic province. The type locality of *r. nigrum* is in the mountains of the Durangan biotic province, which is less distinctly separated from the mountains farther north by a northwest-southeast drainage system. The type localities of *A. r. nigrum* and *A. r. sonoraensis* are separated by a linear distance of more than 500 miles of mountainous terrain.

#### Genus *BOLITOGLOSSA* Duméril and Bibron

##### *BOLITOGLOSSA OCCIDENTALIS* Taylor

*Bolitoglossa occidentalis* TAYLOR, Univ. Kansas Sci. Bull., vol. 27, pp. 145-147, fig. 1, C, pl. 9, figs. 1-4, 1941.

University of Illinois Museum of Natural History No. 3200, collected at Pichucalco, Chiapas, during the summer of 1937, by Clarence Goodnight.

This salamander has been taken previously only on the Pacific slopes of Chiapas. Pichucalco is on the Tabasco border, and this record extends the range of the species across the state, and undoubtedly into Tabasco.

#### Genus *BUFO* Laurenti

##### *BUFO COCCIFER* Cope

*Bufo coccifer* COPE, Proc. Acad. Sci. Nat. Sci. Philadelphia, vol. 18, pp. 130, 131, 1866.

Chicago Museum of Natural History No. 38756, one specimen, a female, from 10 miles east of Apatzingan, Michoacán, collected by F. A. Shannon, July 22, 1941, under a rock in water-saturated ground bordering a small temporary pond.

The toad, a mature female, represents a state record and a considerable eastward extension of the range of the species. Additional specimens will probably lead to a disclosure of subspecific differences, at least of color.

**BUFO CRISTATUS** Wiegmann

*Bufo cristatus* WIEGMANN, Isis von Oken, vol. 26, pp. 660, 661, 1833.

U.S.N.M. No. 123691, from San Lucas Camotlán, Oaxaca. This specimen constitutes a state record. It is somewhat large (78 mm.) for the species, although quite normal in appearance.

"Toad—caught in patio just after a rain when it came into the light of the gasoline lantern in front of the doorway about 9 p. m. The Mixe name for it is *nooch*, which is applied to all toads."

**Genus ELEUTHERODACTYLUS** Duméril and Bibron**ELEUTHERODACTYLUS NATATOR** Taylor

*Eleutherodactylus natator* TAYLOR, Univ. Kansas Sci. Bull., vol. 25, 1938, pp. 394–397, pl. 39, fig. 2; pl. 40, 1939.

U.S.N.M. No. 123686, collected at San Lucas Camotlán, Oaxaca, in the river near the east edge of town at 8:30 p. m.; U.S.N.M. Nos. 123687 and 123688, taken on the edge of the river at 9 p. m. on April 29, 1946; U.S.N.M. No. 123698, caught in the river in the village at 9 p. m., May 7, 1946.

All specimens check well with Taylor's (1939) description and with specimens in the museum of the University of Illinois. They vary in length from 55 to 67 mm.

Miller writes that specimen No. 123686 was brown dorsally with pink on sides and anterior surfaces of hind legs.

**Genus SYRRHOPHUS** Cope**SYRRHOPHUS CYSTIGNATHOIDES** (Cope)

*Phyllobatus cystignathoides* COPE, Proc. Amer. Philos. Soc., vol. 17, pp. 89, 90, 1877.

*Syrrhophus cystignathoides*, NIEDEN, Das Tierreich, Lief. 46, pp. 399–401, 1923.

University of Illinois Museum of Natural History No. 3199, collected at Tamazunchale, San Luis Potosí, July 19, 1737, by Ottys Sanders.

This specimen definitely establishes the presence of *S. cystignathoides* in San Luis Potosí. The specimen is extremely darkened, probably by preservative, the venter being nearly black. In other respects it fits *cystignathoides*.

**Genus HYL A** Laurenti**HYLA BISTINCTA LABECULATA**, new subspecies

FIGURES 92, *a*; 93, *d*

*Holotype*.—U.S.N.M. No. 123689.

*Type locality*.—San Lucas Camotlán, Oaxaca.

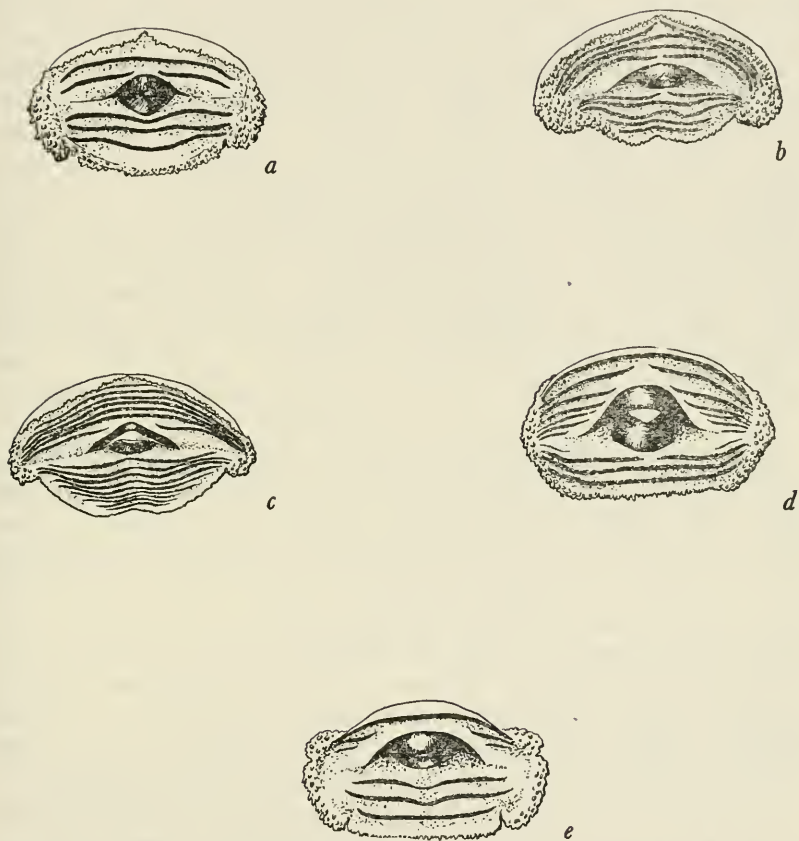


FIGURE 92.—a, *Hyla bistincta labeculata*, new subspecies; b, *Hyla milleri*, new species; c, *Hyla?* sp.; d, *Hyla?* sp.; e, *Rana pipiens austriicola*. (All figures greatly magnified.)

*Collection data.*—The specimen was singing in the river when it was collected at 9:10 p. m., April 29, 1946, by W. S. Miller.

*Diagnosis.*—A large *Hyla* (53 mm.) distinguished from *b. bistincta* by having the gray reticulation of the sides entirely broken up into elongate black blotches; tarsal fold moderately elevated.

*Description.*—Head as broad as long; nostril closer to tip of snout than eye; tympanum quite distinct and as wide as third finger pad; strong fold above tympanum, curving down to terminate above the arm; canthus distinct but rounded, terminating bluntly on snout; ostia of vocal pouches elongate, lying to side of but not beneath tongue; tubercles and webbing of hand not significantly different from those of *b. bistincta*; indistinct outer metatarsal tubercle; moderate overlapping of heels when thighs are at right angles to body and limbs folded; tarsal fold sharp and distinct, extending almost to tibiotarsal joint; heel reaches to or slightly beyond anterior border of eye. Dorsum universally and finely granular; venter pebbly, giving way to coarse tubercles and rugosities on throat; ventral surface of thighs smooth except for a median posterior pebbly area, which extends to the posteroventral aspect of the thigh. No anal fold; no true anal tubercles, although there is a small patch of more distinct pebbly elevations on each side of and beneath anal orifice.

The animal is a nondescript dark brown dorsally (fig. 93, *d*), giving way to creamy areas on the sides. These lateral creamy surfaces are marked with distinct, sharp-edged, well-separated black blotches; dorsum of femur is of the dark ground color broken by creamy patches mingled with black irregular blotches. These broken areas are found on the anterior and posterodorsal areas of the femur; dorsal tibial surfaces colored same as back with quite indistinct small black spots scattered over the surface; tympanal fold and the anterior surface of the sides marked with a black band; feet and hands lighter in color distally; ventral surface of body and extremities cream colored with occasional small gray spots on the distal surface of the thighs.

*Measurements in millimeters.*—Total length 53; head length 20; head width 20; width of upper eyelid 6.5; interorbital width 4.5; eye-nostril 5.0; nostril-tip of snout 2.5; greatest diameter of tympanum 3.0; between nostrils 4.0; between choanae 6.0; width of third finger pad 3.0; width of fourth toe pad 2.0; length of tibia 28.5.

*Remarks.*—Miller says of the living specimen: "Reddish-brown back with tiny black spots; black and white spotted sides and rump."

Aside from the distinctive color pattern, there were no consistent anatomical differences apparent.

A tadpole of this species (U.S.N.M. No. 123690) was caught hopping on the bank half an hour before the type specimen was taken. It has a body length of 22 and a tail length of 21 mm. Black spots are



already distinct on the sides. It is similar to the adult except that a distinct (although quite small) outer metatarsal tubercle is present.

Two additional four-legged tadpoles (field No. F. 22) were taken on May 7 at 9 p. m. from stones jutting out of the stream. The black lateral spots are not so evident on them as they are on the one in the U. S. National Museum but they are present. Both possess small, distinct outer metatarsal tubercles.

A series of five two-legged tadpoles are also tentatively included here as belonging to this subspecies. They strongly resemble the four-legged specimens but the posterior extremities are not well enough developed to be useful for identification. They have the buccal cavity surrounded by a papillary fringe, which is well developed laterally; papillae in two or three rows beneath lower labium and one or two rows above upper; horny beak serrate; upper beak notched medially; labial teeth in two rows in lower jaw, three in upper, with outermost row of upper labium about one and one-half times length of upper beak; innermost row with an interval just above beak; spiracle large, sinistral, and lateral; eyes lateral but clearly visible from above. Tail long and tapering with distinct lateral groove down the side; tail fringe originating about halfway between foreleg anlage and hind limbs.

The type specimen was singing when caught. "There was some argument among the Mixe neighbors as to what was the proper Mixe name. Some insisted it was *anaánooch* (thunder toad), while others said it was *wainky* (untranslatable)."

#### HYLA MILLERI, new species

FIGURES 92, *b*; 93, *a-c*

*Types*.—Holotype, U.S.N.M. No. 123700 male; W. S. Miller collector.

Paratypes: U.S.N.M. No. 123699 and University of Illinois Museum of Natural History No. 3200 males, collected with the holotype.

*Type locality*.—San Lucas Camotlán, Oaxaca.

*Collection data*.—The specimens were collected on stones projecting from the river in the village. They were taken on the night of May 7, 1946, at 9:10 p. m.

*Diagnosis*.—A very small *Hyla* with granular eyelids; sharp canthi terminating bluntly on the snout; two vocal sacs present; subterminal articular tubercle of fourth finger divided; strong web between third and fourth fingers; outer palmar tubercle divided; glandular ridge from this tubercle to elbow; ventral surfaces of thighs strongly granular; throat with widespread scattered pustular protuberances; body uniformly dark tan above.

*Description.*—Head as broad as or slightly broader than long; tympanum distinct, small, less than half the diameter of the eye; tympanum bordered above by an indistinct glandular fold that curves down behind the shoulder and is lost; canthi sharp and passing just inside the external nares, blunted on snout; nostrils closer to tip of snout than to eye; distance from nostril to eye equal to or slightly less than distance between nostrils.

Vomerine teeth prominent, divergent in an anterior direction, extending to or slightly beyond a line drawn between anterior borders of the choanae; tongue as broad as long and notched behind; vocal sacs open into narrow slits on each side of, just beneath edges of, and three-fourths of the way back of tongue.

Finger pads well developed, that of third digit as large as tympanum; prominent granular tubercle on thumb, lying parallel and just anterior to median palm tubercles (which also extend well onto base of thumb); lateral palmar tubercle divided, granular, and indistinct; second and fourth subarticular tubercles slightly larger than third; subterminal articular tubercle on outer finger bifid; supernumerary tubercles prominent on the second and third fingers; indistinct glandular ridge from outer palmar tubercle to the elbow; web between third and fourth fingers extends to the subterminal joint; strong definite web between the second and third fingers; slight webbing between first and second fingers; a marked ridge along lateral aspect of all fingers.

Three metatarsal tubercles present, medial many times larger than lateral; latter represented by a single small punctate elevation; intermediate tubercle indistinct, one-half size of median; foot almost completely webbed as shown in diagram; strong tarsal fold extending almost the length of tibia.

Eyelids of a rough granular appearance caused by many rounded glandular protuberances; entire top of head covered to a lesser extent by widely separated pustules; back with a leathery appearance under magnification, with occasional tiny pustules present; entire venter marked by strong pebbly elevation, especially on ventral surfaces of thighs; an indistinct transverse fold above the anus; no anal tuberosities.

*Color.*—Entire dorsum of specimen dark tan, the color lessening somewhat in intensity on the extremities; venter grayish yellow with indistinct small dark circular blotches on throat. Miller states that the frogs were light tan in life.

*Measurements in millimeters.*—Width of head 10; length of head 10; width of upper eyelid 4.0; interorbital space 4.3; width between nostrils 3.0; nostril to eye 3.0; width of tongue 7.0; length of tongue 6.8 to 7.0; distance between choanae 3.0 to 5.0; diameter of third



FIGURE 93.—a-c, *Hyla milleri*, new species: a, Specimen; b, hand; c, foot; d, *Hyla bistincta labeculata*, new subspecies, holotype.

finger pad 1.5; diameter of fourth toe pad 1.0; tibia 15.5; foot 12.0; total body length 30.5. The tibiotarsal joint reaches to between eye and nostril.

*Variation.*—The other two males are remarkably consistent. U.S.N.M. No. 123699 is not quite so rugose as the holotype and almost entirely lacks gular pigmentation. There is little trace of intermediate metatarsal tubercles, as mentioned in the description of the holotype. All three specimens fall within 0.5 mm. of the same length.

*Remarks.*—This species is most nearly like *Hyla arborescendens*, differing from it in possession of (1) a larger vomerine tooth series, which is also more anteriorly located; (2) canthi meeting bluntly on the snout instead of coming to an angular point; (3) granular eyelids; (4) a bifid outer subterminal tubercle on the hand (although there is a slight tendency for this tubercle to divide in *arborescendens*); and (4) lighter color and smaller size.

Appended is a description of the tadpole of this species which Miller also collected. There is a transitional series present that bridges the gap from the tadpole to the adult.

Each specimen in a series of 10 has 4 legs and the tail in a state of partial absorption. The tadpoles vary from 14 to 17 mm. in snout-vent length and the tails from 7 to 27 mm. They are not as granular as the adults and vary in granularity in proportion to the size. Hand webbing is usually about the same as in the adults, proportional to size, but occasional specimens show slightly less. The outer subterminal articular tubercle varies in the degree to which it is divided. Occasional specimens show bifid third articular tubercles. A tendency toward this is present in the U. S. National Museum paratype.

Each of three tadpoles in another series has only two legs. They measure as follows:

<i>Total length in mm.</i>	<i>Tail length in mm.</i>	<i>Legs</i>
50	35	Small.
48	32	Well developed.
47	32	Well developed.

As the hand webbing of one specimen (which possessed labial teeth) was well developed, it was extracted from beneath the membrane and was found to be identical with the webbing on the hand of the type specimen.

A typical tadpole has the eyes located above the lateral line, but nearer this line than the middorsum; spiracle sinistral, somewhat closer to anus than to tip of snout; spiracle pointing upward and backward; anus dextral; tail insertion anterior to a transverse plane located at level of insertion of hind legs; caudal membrane translucent and flecked with brown dots; upper labium V-shaped and containing four rows of labial teeth, innermost row broken medially just above the horny beak; beak small, black, and serrate; five com-



plete rows of lower labial teeth with evidences of a fragile row almost upon the papillary fringe; lower horny beak small and set well posterior to the upper; papillary fringe completely circumoral; several rows of papillae beneath lower edges of mouth, which gradually thin to one or two rows in the midline; one or two rows of papillae on upper labium; lateral papillary fringe well developed and projecting downward. The general buccal proportions are shown in figure 92, *b*.

HYLA? sp.

FIGURE 92, *c*

Seven specimens, U.S.N.M. No. 123694, part of field No. F. 17a, collected May 6, 1946, in a swift stream just outside San Lucas Camotlán, Oaxaca, by W. S. Miller.

The tadpoles vary from 37 to 47 mm. in total length, with tails from 22 to 31 mm. long. One specimen (total length 43 mm., tail length 26 mm.) is four-legged.

*Description of typical two-legged form.*—Widest diameter of body that between eyes; tail long and tapering with moderately well-developed, colorless fringe, which starts from a point on a plane transecting the body just anterior to the insertion of the posterior extremities; arms fairly well developed (as in all specimens); spiracle sinistral, located just beneath flexure of left elbow; top of head slightly rounded; snout sloping so abruptly downward at a 45° angle from plane of top of head that a transverse fold is produced by this angle; transverse fold located a little posterior to a point midway between tip of snout and anterior corner of eye; another fold or ridge running from just dorsal to eye down to nostril, and from the nostril to side of snout; nostrils slightly closer to eyes than to tip of snout, and separated by a distance equal to that from nostril to tip of snout.

Upper labium extremely broad and pendulous, notched medially and forming a flap covering mouth parts and extending down to lower labium; seven rows of upper labial teeth; three uppermost rows and, to a certain extent, fourth row thin and tending to pinch together medially; six rows complete above horny beak; seventh row divided medially and located at level of top of beak; nine or ten rows of infra-labial teeth, the inner six most strongly developed, and the last three or four fine to point of extinction; papillary border completely circumoral, although papillae reduce to a single row over the dorsal and ventral aspects of the labia.

Web between third and fourth fingers small, not reaching subterminal joints except as a thin fringe along the fingers, is distinct but slight between second and third fingers, faint between first and second fingers.

Color uniform dark brownish black dorsally; tail marbled with brownish purple on a light tan background; abdomen smooth, light yellow-tan.

HYLA? SP

FIGURE 92, *d*

San Lucas Camotlán, Oaxaca, 29 tadpoles unnumbered except for field tags (part of F 15). Caught in the river in the flats below the town, on May 6, 1946.

A somewhat oval body shape with long, tapering, laterally grooved tail; tail fin originating well posterior on dorsum just anterior to vertical plane of insertion of hind legs and terminating in a point; spiracle sinistral, eyes situated more dorsally than laterally; no lateral emargination of papillae; latter complete around lower labium, in only one row; papillary border barely overlapping outer edge of upper row of labial teeth; labial teeth in five well-developed rows with one and usually two tiny auxiliary rows on each side; outermost row of teeth complete above horny beak; second row slightly separated and remaining rows strongly separated by width of upper beak; three lower rows of labial teeth, the innermost row divided medially; upper horny beak only half or slightly more than half width of outermost upper row of labial teeth; both beaks serrate with lower deeply notched anteriorly.

Color dark brown dorsally, mottled with lighter brown on uppermost half of tail; dark color actually giving way to dark brown spots on a tan ground color as tail is approached; ventrally the tan giving way to yellow; tail fin speckled with brownish black dots; total lengths varying from 31 to 74 mm.

As the smaller specimens appear to have differently shaped horny beaks, they were at first separated on this basis and on the basis of size. However, intermediate-sized specimens possess beaks intermediate in nature.

The river where the tadpoles were caught was swift flowing and had a stony bottom with sandy patches.

Genus *Rana* Linnaeus

*RANA PIPIENS AUSTRICOLA* Cope

FIGURE 92, *c*

*R. [ana] h. [alceina] austriicola* COPE, Proc. Amer. Philos. Soc., vol. 23, p. 517, 1886.

*Rana pipiens austriicola* SMITH, Journ. Washington Acad. Sci., vol. 37, p. 409, 1947.

U.S.N.M. No. 123697, from San Lucas Camotlán, Oaxaca. "Large greenish frog—caught in the river in the east edge of the village at about 6:30 p. m."

Four tadpoles were procured from the same locality, which are here interpreted as belonging to this species. Two of them (45 and 39 mm. total length) are badly dessicated. The larger of the other two is 58 mm. in total length and 24 mm. in body length. The caudal membrane starts anterior to the plane of insertion of the hind leg, although on one specimen the ridge extends forward from this hypothetical plane as far as the head; the membrane is large, translucent, and tapers to a point. The eyes are in the lateral plane of the body, although quite visible from above; spiracle lateral, sinistral, pointing up and back, situated closer to anus than snout; anus dextral.

Lateral papillary border of buccal cavity emarginate; upper papillary border extending to a point medial to lateral edge of outer tooth row; lower papillary border in a single row; three upper and three lower rows of labial teeth as shown in figure 92, *e*; upper beak serrate; lower beak slightly serrate.

Color dark above, light below; grayish fine mottling on caudal membrane; intestinal spiral quite visible through abdominal wall.

If the author is correct in assigning these specimens to *austriicola*, the third row of upper labial teeth becomes of possible taxonomic import.

"This frog is called *tuk* in Mixe, a name apparently applied to all frogs, although the tree inhabitants are considered by them to be toads and not frogs."

#### RANA PIPIENS TRILOBATA Mocquard

*Rana trilobata* MOCQUARD, Bull. Soc. Philom. Paris, ser. 9, vol. 1, p. 158, pl. 1, fig. 1, 1899. (Jalisco, Mexico.)

*Rana pipiens trilobata* SMITH, Journ. Washington Acad. Sci., vol. 37, p. 409, 1947.

U.S.N.M. Nos. 123577 to 123579, four specimens, from El Salto, Durango, Ralph G. Miller collector.

Smith (1947) revived the names *austriicola* and *trilobata* for subspecies of *Rana pipiens* from the southern Atlantic coastal areas and the plateau of Mexico, respectively. His description, however, did not include a diagnosis. As the two subspecies are strikingly distinct, the following tabulation is submitted for purposes of bringing out this contrast. Reservations toward the data should be held because of the small number of specimens involved.

#### *trilobata*

Posterior surface of thighs very granular.

Long, strong, raised dorsal glandular ridges with prominent pustules between them.

Heels not or barely overlapping.

Head slightly longer than wide.

#### *austriicola*

Posterior surface of thighs comparatively smooth.

Glandular ridges low, pustules indistinct or absent.

Heels strongly overlapping

Head slightly wider than long.

Genus *ANOLIS* Daudin*ANOLIS LIOGASTER* Boulenger

*Anolis liogaster* BOULENGER, Proc. Zool. Soc. London, vol. 2, p. 245, pl. 6, fig. 2, 1905.

U.S.N.M. Nos. 477748 female, 47749 male, 47750 female, 47751 male, 47752 female, from Omilteme, Guerrero, all collected by Nelson and Goldman.

These specimens are of some interest as they include the only males reported since the single male included in Boulenger's type description. Boulenger states: "The male is remarkable in the absence of the inner digit on the four limbs." His specimen may be regarded as an anomaly, as the two males collected by Nelson and Goldman have the normal quota of five digits on each extremity.

The supraorbital semicircles may touch or be separated by a median row of scales. Supraoculars are three in number but occasional smaller scales may split off from any of the three plates.

*ANOLIS PETERSII* Bocourt

*Anolis petersii* BOCOURT, Mission scientifique au Mexique. Études sur les reptiles, livr. 2, pp. 79, 80, pl. 13, fig. 2; pl. 15, figs. 11, 11a, 1873.

U.S.N.M. No. 12244, three specimens, from Mirador, collected by Dr. Sartorius.

*ANOLIS SERICEUS* Hallowell

*Anolis sericeus* HALLOWELL, Proc. Acad. Nat. Sci. Philadelphia, vol. 8, pp. 227-228, 1856.

U.S.N.M. Nos. 123703 female, and 123704 male, from Cacalotepec, Oaxaca, collected by W. S. Miller; U.S.N.M. No. 47391, from San Miguel Albarradas, Oaxaca, collected by Nelson and Goldman.

Miller states that the male was light tan above with white arrowlike markings, edged in dark brown with apices pointed toward the tail. These are lateral in distribution. He says of the dewlap: "A distensible bladelike skin pouch. As the lizard sat sunning itself it would recurrently distend this fan. The effect was startling. The sun shining through the distended thin skin made even more marked the contrast between the reddish salmon color of the throat sack and the over-all color of the animal." There is a purplish spot on the posterior portion of the dewlap, as is characteristic of the species.

Miller says that the female in life had a light magenta line on a dark brown ground color.



Genus *SCELOPORUS* Wiegmann*SCELOPORUS SCALARIS SCALARIS* Wiegmann

*Sceloporus scalaris* WIEGMANN, Isis von Oken, vol. 21, p. 370, 1828.

*Sceloporus scalaris scalaris* SMITH, Occ. Pap. Mus. Zool. Univ. Michigan, No. 361, pp. 2, 3, 1937.

U.S.N.M. No. 123582, from El Salto, Durango, collected by Ralph G. Miller.

Varies from the normal in that the specimen has the blue spot on the anterior portion of the black shoulder marking instead of in the middle of this spot. Also the tibia is only about 85 percent of the length of the head, instead of the customary 90 percent or more. There are two canthals.

*SCELOPORUS SPINOSUS CAERULEOPUNCTATUS* Smith

*Sceloporus spinosus caeruleopunctatus* SMITH, Kansas Univ. Sci. Bull., vol. 24, pp. 469-473 (1936), 1938.

U.S.N.M. No. 123706 female, from near Santa Maria Albarradas, Oaxaca, collected by W. S. Miller on May 22, 1946.

Dorsal scale rows 30 (31 or more in 90.7 percent); femoral pores 9-9 (10 or more in 87.4 percent). Smith (1939, p. 98) points out that other specimens from Oaxaca show these low counts. However, as his specimens are from over 50 miles south of Santa María Albarradas, and as the zone of intergradation between *s. spinosus* and *s. caeruleopunctatus* is near Albarradas, the low counts of Miller's specimens may best be explained as evidence of intergradation with the former.

The Mixe name for the lizard is *chintete*.

Genus *XENOSAURUS* Peters*XENOSAURUS GRANDIS* (Gray)

*Cubina grandis* GRAY, Ann. Mag. Nat. Hist., ser. 2, vol. 18, p. 270, 1856.

*Xenosaurus grandis* COPE, Proc. Acad. Nat. Sci. Philadelphia, vol. 18, p. 322, 1866.

U.S.N.M. No. 123705, from San Lucas Camotlán, Oaxaca, at 8:00 a. m., April 14, 1946.

Miller states that the lizard lives in cracks in large rocks. During the day it may be seen resting here with only the head protruding. The specimen caught was in the act of shedding its skin. It was located on the shady side of a rock cliff just a short way from a crevice. The Mixe name is *puknem*.

The living specimen, according to Miller, had an orange eye with a black pupil. The head and neck were spotted with light tan spots, and two light tan V-shaped marks. The body bands were likewise of this light tan, although they gradually darkened to a dark tan on the tail. The gular region was light salmon, and the abdomen brown with black-splotched irregular bands.

Genus *NINIA* Baird and Girard*NINIA SEBAE SEBAE* (Duméril, Bibron, and Duméril)

*Streptophorus sebae* DUMÉRIL, BIBRON, and DUMÉRIL, *Erpetologie générale*, vol. 7, pt. 1, 515, 1854.

*Ninia sebae sebae* SCHMIDT and ANDREWS, *Publ. Field Mus. Nat. Hist., zool. ser.*, vol. 20, p. 170, 1936.

U.S.N.M. Nos. 123711 male, and 123710 female, from San Lucas Camotlán, Oaxaca. The female was taken at 8:00 p. m. on a big rock extending into the river in the center of town. The male was caught 20 minutes later within a few feet of where the female was taken.

There are 19 scale rows in both specimens. Male ventrals 151, caudals 50; female ventrals 147, caudals 52. The male ventrals are high in number for the subspecies, as they are usually less than 140.

Ground color of the living specimens was red with contrasting black bands.

Genus *TANTILLA* Baird and Girard*TANTILLA PHRENITICA* Smith

*Tantilla phrenitica* SMITH, *Zoologica*, vol. 27, p. 39, 1942.

U.S.N.M. No. 123707 female, from Oaxaca, taken on trail just west of Camotlán at 5:30 p. m. "The day had been hot, but it now clouded over and began to thunder, threatening rain."

Total length 280 mm.; tail 46 mm.; scales in 15 rows; ventrals 146; caudals 36; mental contacts chin shields.

The specimen was black above, salmon colored below. A flesh-colored band crosses the back of the head involving the tips of the parietals.

Genus *THAMNOPHIS* Fitzinger*THAMNOPHIS CHRYSOCEPHALUS* (Cope)

*Eutaenia chrysocephalus* COPE, *Proc. Amer. Philos. Soc.*, vol. 22 1884, pp. 173, 174, 1885.

*Thamnophis chrysocephalus* SMITH, *Zoologica*, vol. 27, p. 104, 1942.

U.S.N.M. No. 123708 male, from San Lucas Camotlán, Oaxaca, taken April 16, 1946, in right-hand fork of the river located in the west end of the town.

Miller writes of this specimen: "Over-all color dark brown with black spots. Dorsal line light greenish brown near head, becoming darker farther back of the anus. Belly a bluish gray. On sides a very light tan stripe runs from base of jaws to just back of anus where it almost disappears, blending into belly." Mr. Miller's description is accompanied by a sketch, demonstrating the distinct nature of the

stripe. Unfortunately the single specimen obtained has suffered dehydration at one time or another, and while it has been beautifully restored with trisodium phosphate, the lateral stripes can barely be made out. The dorsal stripe can be noted only by considerable manipulating and a maximum of wishful thinking. As a matter of fact, the dark spots between the stripes can hardly be distinguished. The anterior dozen ventrals show much more black pigmentation than is common for this species.

Though a dorsal stripe on the back of *chrysocephalus* may eventually prove to be of subspecific value, it is obvious that no reliable diagnosis may now be attempted on the basis of a single dehydrated specimen. The specimen does occur on the southeastern edge of the known range for the species, and other striped specimens may be found to the south and east and possibly to the south and west nearer the coast. In fact, Smith (1942) records such a specimen, EHT-HMS 23778, from Omilteme, Guerrero, which has a light stripe on the mid-dorsal row of scales fading out about an inch behind the head; two others in the British Museum of Natural History, from Omilteme, Guerrero, and Jalapa, Veracruz, are similar (fide Smith, in conversation).

### Genus BOTHROPS Wagler

#### BOTHROPS NUMMIFER VERAECRUCIS Burger

*Bothrops nummifer veracrucis* BURGER, Bull. Chicago Acad. Sci., vol. 9, pp. 59-67, pl. 1, fig. 1, 1950.

U.S.N.M. Nos. 123709 male, and 123712 female, from 4 miles south of San Lucas Camotlán, Oaxaca.

Both specimens were taken while sunning in a chili patch 4 miles from the town. The eyes of the male were a bright golden-flecked color in life. The pupil was narrowed "to a mere pin point of black." There were beautiful dark brown markings on a lighter brown ground color. In most instances the dark brown marks were separated by a faint whitish edging.

Two field mice were extracted from the male.

The Mixe name for the snake is *puhk*.

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## CHAETODON TINKERI, A NEW SPECIES OF BUTTERFLY-FISH (CHAETODONTIDAE) FROM THE HAWAIIAN ISLANDS

By LEONARD P. SCHULTZ

RECENTLY Spencer Tinker, of the Waikiki Aquarium, kindly sent to the United States National Museum three specimens of a rare butterflyfish, taken in a fish trap at a depth of 15 fathoms off Nanakuli, Oahu, T. H. Comparison of these specimens with material in the national collections and considerable study of the vast literature on this group of fishes reveal that they represent a new species, which I take pleasure in naming for Mr. Tinker, in appreciation of his permission to report upon it. I wish to thank Loren P. Woods, curator of fishes, Chicago Natural History Museum, for confirming my opinion that this is a new species.

### Family CHAETODONTIDAE

#### Genus CHAETODON Linnaeus

*Chaetodon* LINNAEUS, *Systema naturae*, ed. 10, pp. 242, 272, 1758.

#### CHAETODON TINKERI, new species

#### PLATE 15

*Holotype*.—U.S.N.M. No. 111976, off Nanakuli, Oahu, T. H., 1949, depth 15 fathoms, preserved by Spencer Tinker, standard length 114 mm.

*Paratypes*.—U.S.N.M. No. 111977, 2 specimens, taken along with the holotype and bearing same data, 102 to 112 mm.

*Description*.—The following counts are recorded first for the holotype then for the paratypes, respectively: Dorsal rays XIII, 18; XIV, 19 and XIII, 21; anal rays III, 17; III, 16; and III, 16; pectoral I, i, 13 in all specimens; pelvics always I, 5; branched caudal fin rays 8+7; 8+7; 8+7; scale rows from upper edge of gill opening to base of caudal fin 34; 37 and 36.

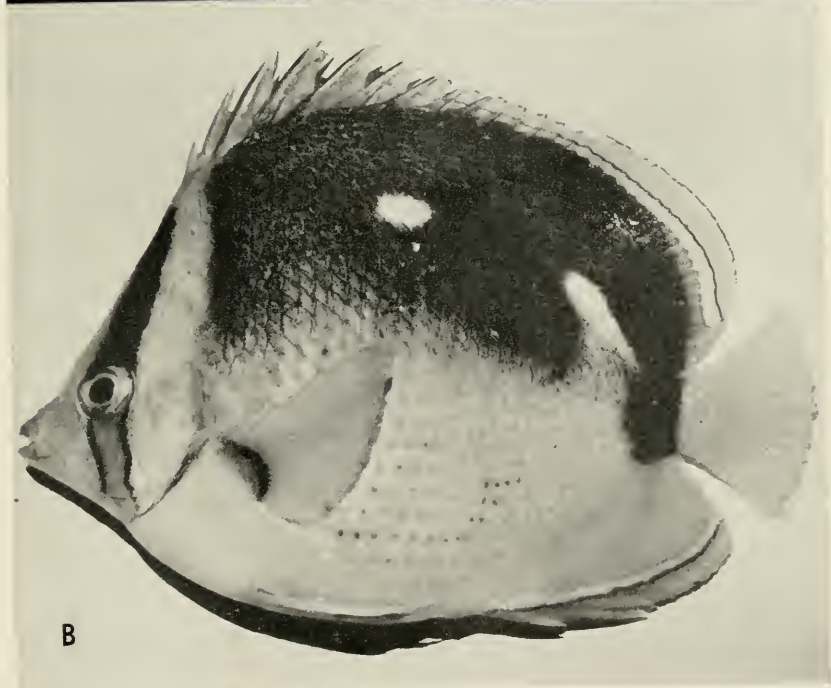
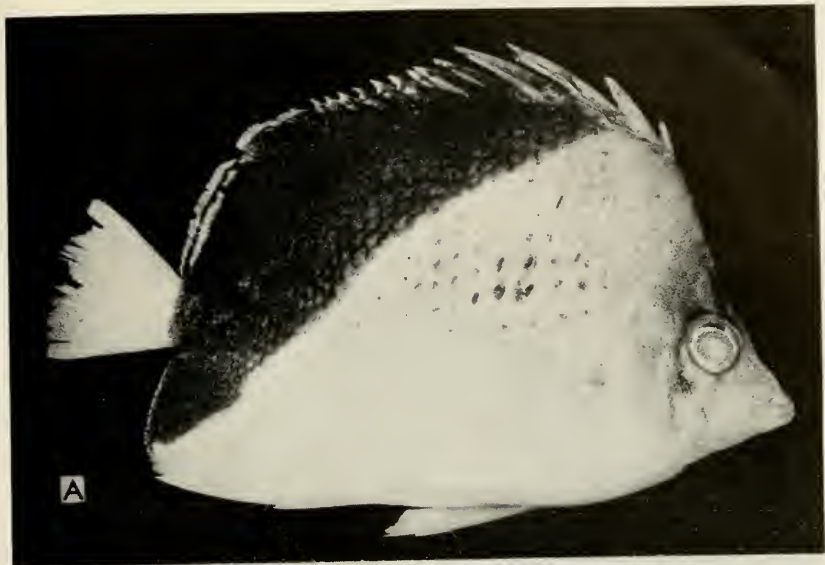
Certain measurements were made, and these, expressed in thousandths of the standard length, are recorded first for the holotype and then for the paratypes, respectively. Standard lengths in mm. 114; 112 and 102. Greatest depth of body 632; 638 and 628; length of head to rear of fleshy operculum 318; 295 and 304; postorbital length of head 129; 130 and 130; length of snout 127; 112 and 108; diameter of eye 97; 93 and 101; least depth of caudal peduncle 105; 103 and 98; length of pectoral fin 263; — and — (broken); length of pelvics 272; 266 and 270; longest dorsal, third or fourth spine, 285; 268 and 284; longest soft dorsal ray 158; 179 and 137; longest anal spine, second, 290; 250 and 275; longest soft anal ray 255; 228 and 245; angles formed by dorsal and ventral profiles of head  $80^{\circ}$  to  $95^{\circ}$ .

*Color in alcohol.*—Ocular band present but indistinct, edges brownish, central area pale, wedge-shaped above eye, oblong below eye, with a central area of brownish sometimes a streak in form of a small blotch; ocular band faintly visible on subopercle, but not occurring on breast or under side of head; snout pale; upper lip a little dusky; pelvics pale; caudal fin pale except a narrow blackish posterior edge, broken off on holotype and one paratype; posterior-dorsal part of body and dorsal fin with a broad black band extending from base of second dorsal spine obliquely across body and posterior part of anal fin a little behind tips of anal spines; margin of dorsal fin white, with a narrow black submarginal streak from tip of fourth dorsal spine to last dorsal soft ray, then below this on soft dorsal a narrow white band somewhat broken; anal fin narrowly margined with white; anterior ventral part of body pale or white, with center of each scale marked with a small brownish spot; several of these spots are especially intense brown behind and above axil of pectoral fin.

*Color when alive.*—Pale part of body probably was yellow, as some of this color was present when specimens were received.

*Remarks.*—Since the finding of an unnamed butterflyfish is a rare occurrence, special care was taken to search the literature for species close to the new one. None of the important contributions on the Chaetodontidae or faunal studies that are listed in the accompanying Literature Cited contain the present species from the Hawaiian Islands, and it does not appear in any of the works on the fauna of that area.

*Chaetodon tinkeri*, with no vertical oblique or lengthwise dark streaks on the sides, no transverse dark bars on caudal fins, and no black pelvic fins, differs from a vast group of species; among those with black snouts it is closest to *C. nigriventris* (Gill) (fig. 94) of the eastern tropical Pacific, but *tinkeri* differs in having a pale snout and in lacking black on the posterior border of the gill cover; the chief resemblance is a broad black band dorsally. *C. tinkeri* resembles



A, One of the paratypes of *Chaetodon tinkeri*, new species; photograph by Spencer Tinker.  
B, *C. quadrimaculatus* Gray, from the northern Marshall Islands.





but two species of *Chaetodon* that have white snouts, *C. quadrimaculatus* Gray and *C. nippon* Döderlein. The latter species lacks the rows of brownish spots on the sides so prominent in *C. tinkeri*; the broad dark band is more vertical in position in *nippon* than it is in *tinkeri* and covers most of the anal fin in *nippon*, whereas in *tinkeri* the anterior two-thirds is white or pale; *nippon* lacks the submarginal

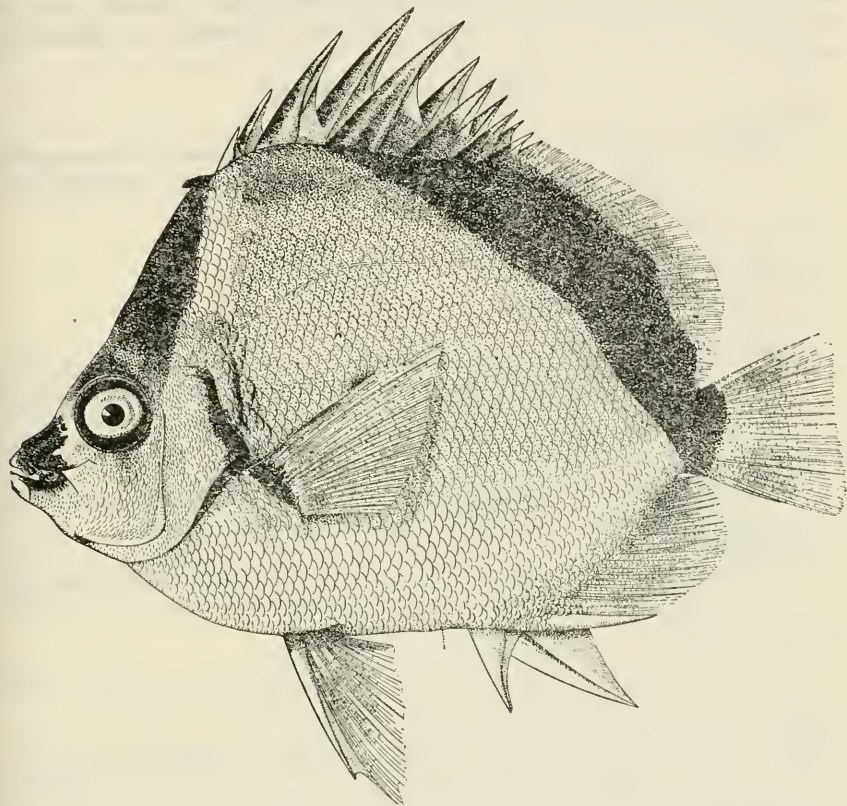


FIGURE 94.—*Chaetodon nigrirostris* (Gill) from Clarion Island.

dark streak and then a white streak on the dorsal fin; the pelvics of *nippon* are dusky or blackish but white in *tinkeri*. My comparison of *nippon* was based on Steindachner and Döderlein's plate 4, figure 2; on the six types of *Chaetodon decipiens* Ahl, 1923, from Misaki, Japan, U.S.N.M. Nos. 5082 and 72111; and on *Chaetodon carens* Seale, 1910, as figured by Herre and Montalban in their plate 15, figure 2. Two other species have been referred to *nippon* as synonyms by authors, *Chaetodon ocellifer* Franz, 1910, plate 4, figure 35, and *Osteochromis larvatus* Franz, 1910, plate 5, figure 43, both from Japan, neither of which closely resembles *C. tinkeri*.

There remains but a single species, *Chaetodon quadrimaculatus*, that is close to *C. tinkeri* and that occurs in the Hawaiian Islands. Both

species have brownish spots on the centers of the scales on the sides in the pale area; the broad blackish dorsal band on *C. quadrimaculatus* covers practically the entire dorsal half of the body anteriorly, whereas that area on *tinkeri* is white, and there are usually two distinct white areas in the black band of *quadrimaculatus*, which are lacking in *tinkeri*; the anal fin of *quadrimaculatus* is white except for a submarginal black streak, whereas in *tinkeri* the black band extends down to include the posterior third or more. These differences are illustrated on plate 15.

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## MOTHS OF THE GENUS *PARAMULONA* HAMPSON

By WILLIAM D. FIELD

The lepidopterous genus *Paramulona*, described by Hampson in 1900, is native to Cuba and is found only on that island. The present study of these moths is based upon material from the collections of the United States National Museum and the British Museum of Natural History. Arthur D. Cushman, of the United States Bureau of Entomology and Plant Quarantine, made the drawings for figures 95, *e*, and 96, *i* and *j*. The rest of the drawings are my own work.

Family ARCTIIDAE

Subfamily LITHOSIINAE

Genus *PARAMULONA* Hampson

*Paramulona* HAMPSON, Catalogue of the Lepidoptera Phalaenae in the British Museum, vol. 2, p. 386, 1900.—DRAUDT, in Seitz, Gross-schmetterlinge der Erde, vol. 6, pp. 251, 252, 1918.—STRAND, in Wagner, Lepidopterorum catalogus, pars. 26, p. 732, 1922.—FORBES, Scientific survey of Porto Rico and the Virgin Islands, vol. 12, pt. 1, pp. 32, 33, 1930.

*Type*.—*Mieza albulata* (Herrich-Schaeffer) (type by original designation).

Labial palpus upturned, nearly reaching vertex of head.

Antennae of male and female bipectinate; pectinations originating ventrally on posterior half of subsegments; with a pair of bristles on each pectination, one long and placed apically on pectination (except in *Paramulona baracoa*, where this bristle is subapical), the second shorter and below the first; pectinations ciliate. Male with pectinations narrowly fused at base and usually with pectinations of middle subsegments long, twice or more as long as width of subseg-



ments (except in *P. baracoa*, where the pectinations are short). Female with pectinations broadly fused at base and with pectinations of middle subsegments short, shorter than width of subsegments.

Venation of forewing with vein 2 from outer third of cell or before and past middle, downward curved at base; veins 4 and 5 separate, 4 from lower angle, 5 from slightly above lower angle (see under Remarks); 6 from below upper angle of cell; 7 from stalk of 8 and 9; 10 and 11 free; 10 from middle or nearer stem 7, 8, and 9 than to 11; 11 from beyond middle of cell and curved toward 12, distally coincident with 12.

Venation of hindwing with 2 from outer third of cell or beyond; 3 stalked with 4 from lower angle of cell; 5 absent; 6 and 7 usually stalked from upper angle of cell, sometimes separate; 8 from before middle of cell.

Male with one or two long and shallow, suboval scale pouches on the abdomen. One between fifth and sixth tergites in all the species and one between sixth and seventh tergites in all the species except *Paramulona albulata*. These pouches slightly bilobed anteriorly.

Male genitalia (figs. 95, *a-c*; 96) with curved and hooklike uncus terminating in a constricted and slightly elongate point; gnathos absent; anellus present and with weakly sclerotized ventral plate or juxta and two small dorsal plates; vinculum broadly U-shaped; inner surface of harpe with fingerlike lobe from costa, this lobe fused with harpe along its entire length; aedeagus short and broad; vesica armed with scobinations and numerous long spinelike cornuti and with a single cornutus shaped like a rose thorn; bulbus ejaculatorius from dorsal part of anterior end of aedeagus.

Female genitalia (fig. 95, *d, e*) with a single genital plate, this plate posterior to ostium bursae and bilobed with lobes extending anteriorly into two pockets; ostium bursae between seventh and eighth segments; ductus bursae lightly sclerotized, broad and long and convoluted; entrance to bursa copulatrix armed with a large circlet of clawlike spines and with a dense cluster of these spines just beyond and to the right of this circlet; bursa copulatrix subspherical and with a single subcordate and denticulate signum near or at anterior end.

*Remarks.*—In the type specimen of *Paramulona albulata* (Herrich-Schaeffer) veins 4 and 5 of the forewing are stalked (on both sides). This specimen was studied by Hampson and formed the basis for his description of the genus *Paramulona*. Dr. M. E. Hering has checked the venation of the type specimen for me and reports that Hampson was correct in his description and illustration of veins 4 and 5 in the forewing. In the 16 specimens of *albulata* studied by me these veins are separate. Hence the type specimen of *albulata* is a freak in that respect.



## KEY TO THE SPECIES OF PARAMULONA

1. Males----- 2  
Females----- 5
2. Harpe with fingerlike clavus from sacculus; vesica with cornuti very thick and long, over half width of posterior end of aedeagus and not numerous (about 1 dozen)-----*nephelistis* (Hampson)  
Harpe without clavus or with clavus a broad and short triangular lobe; vesica with cornuti not so thick usually not so long and always more numerous (about 3 dozen)----- 3
3. Harpe without clavus and with a long shallow ridge on outer surface parallel to sacculus; basal lobes of juxta long and slender, as long as width of juxta at top-----*albulata* (Herrich-Schaeffer)  
Harpe with clavus a broad and short subtriangular lobe; basal lobes of juxta short and thick, much less than width of juxta at top----- 4
4. Harpe with notch near and just beyond middle of apex; aedeagus constricted just behind posterior end-----*schwarzi*, new species  
Harpe with notch before middle of apex; aedeagus not constricted just behind posterior end-----*baracoa*, new species
5. Genital plate mesially notched along posterior edge-----*nephelistis* (Hampson)  
Genital plate not notched but rounded along posterior edge.  
*albulata* (Herrich-Schaeffer)

## PARAMULONA NEPHELISTIS (Hampson)

FIGURE 95, *a-c*, *e*

*Cincia nephelistis* HAMPSON, Ann. Mag. Nat. Hist., ser. 7, vol. 15, pp. 436, 437, 1905; Catalogue of the Lepidoptera Phalaenae in the British Museum, Supplement, vol. 1, pp. 700, 701, 1914.—DRAUDT, in Seitz, Gross-schmetterlinge der Erde, vol. 6, p. 252, 1918.—STRAND, in Wagner, Lepidopterorum catalogus, pars. 26, p. 733, 1922.

*Paramulona nephelistis* (Hampson), FIELD, Proc. U. S. Nat. Mus., vol. 100, p. 326, 1950.

*Male*.—Palpus light fuscous-brown, light straw colored at the tip. Scales of outer sixth and basal half of antenna pale ochraceous white. The two-thirds of the antenna below outer sixth fuscous. Head fuscous with ochraceous fringe at vertex and ochraceous scales above base of palpi. Mesoscutum, patagium, and tegula fuscous with longitudinal stripes of ochraceous. Legs ochraceous, banded with light fuscous. Abdomen pale ochraceous below and somewhat darker, more brownish above. Forewing above pale ochraceous with fuscous scales along the veins and with large fuscous patches in the center and base. Outer margin bordered with ochraceous, especially at apex. Forewing below pale fuscous except along inner margin, where the color is lighter and sordid white. Hindwing above sordid white, slightly darker toward apex and outer margin. Hindwing below sordid white except along foremargin and apex, where the color is darker and more of a fuscous.

Length of forewing 10 mm.

Male genitalia as characterized in the key and as illustrated by figure 95, *a-c*.

*Female*.—*Habitus* similar to that of male, dark fuscous areas on fore wings above more extensive and with ochraceous along costal margin extending inward to cell. With ochraceous patches just beyond cell and directly below cell, this ochraceous sometimes slightly pinkish.

Length of forewing 10–13 mm.

Female genitalia as characterized in the key and as illustrated by figure 95, *e*.

*Type locality*.—"Mutijas, Cuba." I find no trace of any such locality and believe it is a mistake for Matanzas.

*Additional type data*.—Holotype of *nephelistis* is a male (♂ genitalia preparation, British Museum No. 1947–261).

*Location of type*.—In British Museum of Natural History.

*Distribution*.—CUBA: *Province of Matanzas*, Matanzas (May); *Province of Oriente*, Santiago de Cuba (February, March, June, July).

Twenty-one specimens (all available) dissected and studied.

*Remarks*.—The genitalia of the type of *nephelistis* (genitalia preparation, British Museum No. 1947–261) were compared and found to agree with the genitalia of a male (genitalia preparation, British Museum No. 1949–77) from Santiago, Cuba, by D. S. Fletcher, of the Department of Entomology, British Museum of Natural History. This compared specimen was lent to me and is illustrated by figure 95, *a-c*.

PARAMULONA ALBULATA (Herrich-Schaeffer)

FIGURES 85, *d*; 96, *a-c*

*Mieza albulata* HERRICH-SCHAEFFER, Correspondenz-blatt zoologisch-mineralogischen Vereins in Regensburg, vol. 20, p. 120, 1866.—DEWITZ, Mittheilungen des Münchener Entomologischen Vereins, vol. 1, p. 95, 1877.

*Paramulona albulata* (Herrich-Schaeffer), HAMPSON, Catalogue of the Lepidoptera Phalaena in the British Museum, vol. 2, p. 386, fig. 300, 1900.—DRAUDT, in Seitz, Gross-schmetterlinge der Erde, vol. 6, p. 252, fig. 34 c 8, 1918.—STRAND, in Wagner, Lepidopterorum catalogus, pars 26, p. 732, 1922.—WOLCOTT, Journ. Dept. Agr., Porto Rico, vol. 7, No. 1, p. 158, 1923; vol. 20, No. 1, p. 415, 1936.—FORBES, Scientific survey of Porto Rico and the Virgin Islands, vol. 13, pt. 1, p. 33, 1930.

*Male*.—Palpus, antenna, head, thorax, and legs entirely like *Paramulona nephelistis*. Forewings above very similar to *nephelistis*, fuscous along veins more distinct, fuscous patches more extensive and ochraceous along outer margin more distinct.

Length of forewing 8–12 mm.

Male genitalia as characterized in the key and as illustrated by figure 96, *a-c*.

*Female*.—Habitus like that of male and similar to female *Paramulona nephelistis*. Forewing darker, more suffused with fuscous, separate fuscous patches not so distinct.

Length of forewing 10–13 mm.

Female genitalia differing from *nephelistis* in the shape of the genital plate as described in the key and as illustrated by figure 95, *d*.

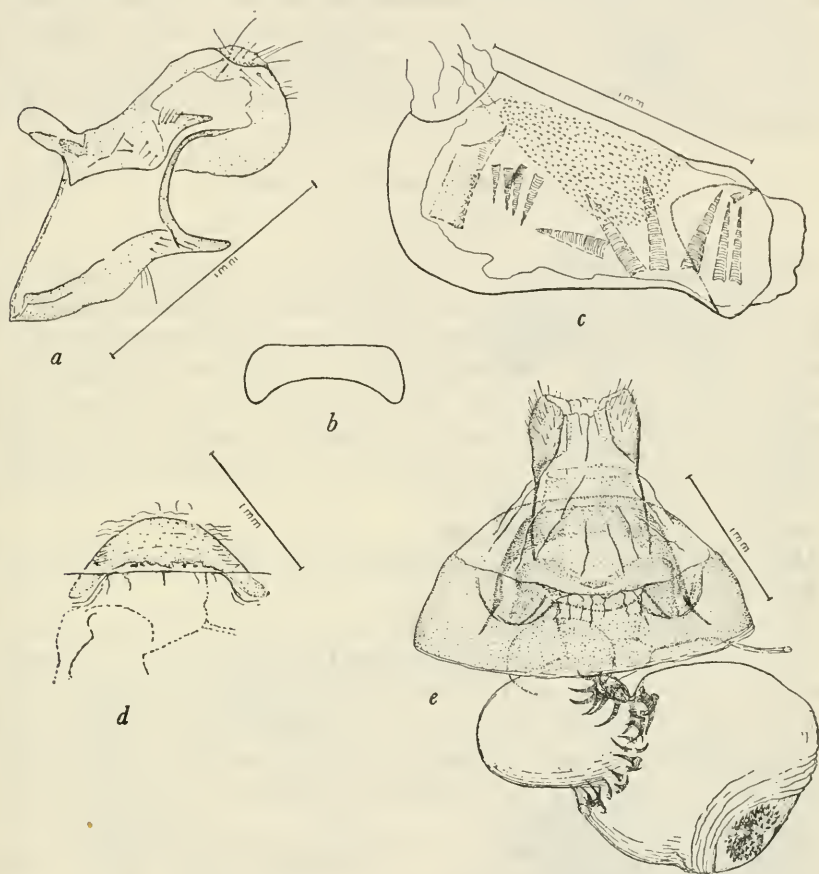


FIGURE 95.—*a-c*, *Paramulona nephelistis* (Hampson): *a*, Inner face of right harpe; *b*, juxta; *c*, aedeagus, lateral view. *d*, *P. albulata* (Herrich-Schaeffer), genital plate of female. *e*, *P. nephelistis*, female genitalia.

*Type locality*.—Cuba.

*Additional type data*.—Described from a single specimen, the holotype, male.

*Location of type*.—In the Herrich-Schaeffer collection, Zoological Museum of the University of Berlin.

*Distribution*.—CUBA: *Province of Habana*, Habana, Santiago de Las Vegas (January); *Province of Matanzas*, Matanzas (March, May,

July); *Province of Santa Clara*, Cienfuegos. This species was recorded from Puerto Rico by Dewitz (loc. cit.). This record is probably a mistake.

Sixteen specimens were studied.

*Remarks.*—The genitalia of the type of *albulata* was studied by Dr. E. M. Hering, of the Zoological Museum of the University of Berlin, and found to be the species illustrated in the present paper as figure 96, *a-c*. Dr. Hering writes that the anellus, harpes, and aedeagus are identical. There is a slight individual difference in that the type of *albulata* has the apex of the harpe slightly more excavated but not nearly so much as in *P. baracoa* (fig. 96, *g*).

### 3. PARAMULONA BARACOA, new species

FIGURE 96, *g-j*

*Male.*—Palpus dark brown, straw colored and slightly pinkish at tip. Antenna, head, thorax, and legs similar to *Paramulona nephelistis*. Scape of antenna pinkish and with considerable pink and light-colored areas of legs. Forewing similar to *nephelistis* and *albulata*, darker fuscous than in either. Outer margin pale ochraceous, contrasting strongly with the fuscous behind the margin. Hindwing above and below and forewing below as in *nephelistis* and *albulata* with fuscous slightly darker.

Length of forewing, 8.5–10 mm.

Male genitalia with characters as given in the key and as illustrated.

*Female.*—Unknown.

*Type locality and distribution.*—Baracoa, Province of Oriente, Cuba.

*Additional type data.*—Described from the holotype, male (locality as above; William Schaus; U. S. N. M. No. 34819; ♂ genitalia preparation W. D. F. No. 2481, 1947) and paratypes Nos. 1, 2, males (same locality; William Schaus; ♂ genitalia preparation W. D. F. No. 3079, 1949, for paratype No. 1; ♂ genitalia preparation W. D. F. No. 2480, 1947 for paratype No. 2).

*Location of types.*—Holotype and paratypes Nos. 1 and 2 in the United States National Museum.

### 4. PARAMULONA SCHWARZI, new species

FIGURE 96, *d-f*

*Male.*—Palpus fuscous, basal subsegments with many ochraceous scales and base and tip of apical subsegment ochraceous. Frons fuscous below and ochraceous above. Vertex of head, patagium, tegula and thorax, ochraceous with scattered fuscous scales. Legs as in *Paramulona nephelistis*, ochraceous color with pinkish tinge. Forewing ochraceous, irrorated with fuscous scales, this irroration more



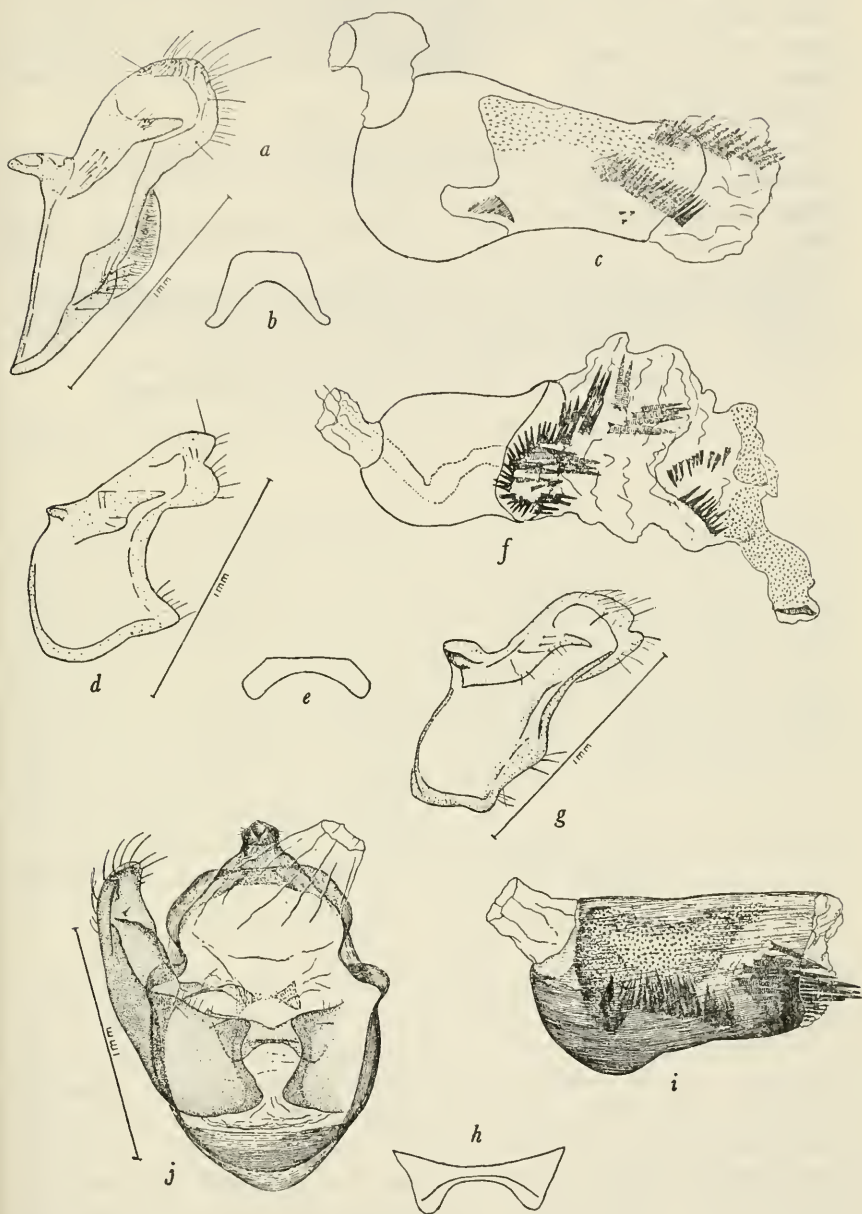


FIGURE 96.—*a-c*, *Paramulona albulata* (Herrich-Schaeffer): *a*, Inner face of right harpe; *b*, juxta; *c*, aedeagus, lateral view. *d-f*, *P. schwarzi* Field: *d*, Inner face of right harpe; *e*, juxta; *f*, aedeagus, lateral view. *g-j*, *Paramulona baracoa* Field: *g*, Inner face of right harpe; *h*, juxta; *i*, aedeagus, lateral view; *j*, male genitalia, ventral view.

heavy in the base; with a faint irregular submarginal band and a faint broken fuscous band through middle of cell and continued to inner margin; with faint fuscous streaks opposite end of cell between these two bands. Forewing below and hindwing above and below as in *nephelistis*.

Length of forewing 8 mm.

Male genitalia as characterized in the key and as illustrated.

*Female*.—Unknown.

*Type locality and distribution*.—Cayamas, Province of Santa Clara, Cuba.

*Additional type data*.—Described from a single specimen, the holotype, male (locality as above; January 27; E. A. Schwarz; U. S. N. M. No. 34821; ♂ genitalia preparation W. D. F. No. 1342, 1941).

*Location of type*.—In the United States National Museum.



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## NEW FINDS OF PLEISTOCENE JAGUAR SKELETONS FROM TENNESSEE CAVES

By EDWARD McCRADY, H. T. KIRBY-SMITH, and HARVEY TEMPLETON

ONLY very recently has Pleistocene jaguar material been recognized in North America, and thus far extremely few parts have been described in the literature. Aside from *Panthera atrox*, which is now considered a closely related species, only about 12 or possibly 14 fragments that can be assigned to very close relatives of the modern *Panthera onca* have been mentioned in print. Probably the most important feature of the two finds here recorded is the fact that together they include nearly every bone in the body. Accordingly, it should now be possible for the first time to determine fairly definitely the relationships of the extinct form.

We are indebted to the Carnegie Foundation and to the University of the South for grants that made this study possible.

### OCCURRENCE OF THE NEW MATERIAL

This paper is concerned with two skeletons found in caves in the St. Louis limestone of the Cumberland Plateau in Tennessee. The first was discovered by the three of us in 1944 in Little Salt River Cave in Franklin County, near the Tennessee-Alabama border. This is an active cave with a stream running through the main passage and issuing on the valley floor. The skeleton was found approximately one-half mile from the entrance in an upper passage accessible only by means of a short vertical climb of some 15 feet. The passage is low (about 30 inches high) and broad (15 to 30 feet), and is richly ornamented with very remarkable helictites. At what originally appeared to be its end, the passage is crossed by a screen of stalactite

columns, so closely spaced that only a near approach discloses the presence of a room beyond. Breaking through, we discovered the cat bones on the inner, or blind side of the rock columns. The animal had lain down on its left side on a wet clay floor to die, and the bones had sunk partly into the clay before drippings from a crack in the roof started the slow process of sealing up everything under a layer of calcium carbonate. The rock had accumulated to a thickness of 1 to 3 inches on top of the clay, leaving only a few parts projecting above, and these exposed portions were themselves encrusted with a thin spatter deposit about an eighth of an inch or less in thickness. We found that by using hammers and chisels we could remove the rock in plates from the surface of the clay, which was still wet and soft beneath, and that the ends of the bones that projected into the clay were cleaned effectively with just a little washing. The other portions, however, were very much more difficult to free from their matrix. On the suggestion of Dr. C. S. Piggot, who at that time was executive director of the Committee on Geophysical Sciences of the Research and Development Board of the National Military Establishment, Dr. C. L. Gazin, curator of the division of vertebrate paleontology of the United States National Museum, came to our assistance and very kindly arranged to have the skeleton cleaned by some of the members of his staff.

The second discovery was made by us in Saltpeter Cave, just north of Sparta, in White County, Tenn., in the fall of 1947. About half a mile back in the cave, in a large room at least 40 feet high and having a dry, loose, sandy earth floor, we uncovered the second skeleton, about as extensive as the first and in many details conveniently complementary. Since it was not encased in rock, it was easily cleaned, but was very fragile.

Each individual was intact when originally deposited in the cave, and the situation of each virtually precludes the possibility of the carcass having been washed in from the outside. The first was found in a high upper passage with no entrance large enough for such a body except the one by which we came, and water definitely did not flow that way. The second was found in a dry cave, located several hundred feet above the present valley floor, that must have been dry at the time the cat died and probably long before that. (All the caves in the Sparta area have their entrances high up on the sides of the mountains and seem to have been formed at a time when the valley floor was several hundred feet higher than it is today.) Both locations are at least half a mile from the entrances of the caves, too far back for casual migrants, so there is every reason to believe that both cats reached the spots in which we found them under their own power. Very few kinds of animals penetrate caves beyond the twilight area near the mouth. It is possible, of course, that sick or injured animals wander farther back to die, but it seems much more



probable, in view of the distances involved and the difficulty of access in one case, that these cats, like cave bears, cave rats, and racoons, frequented the inner recesses of caves, a habit not previously attributed to any members of the cat family in America so far as we know, although *Felis leo spelaea* in Europe was a lion that seems to have frequented caves.

#### EXTENT OF THE NEW DISCOVERIES

The specimen from Salt River Cave has been deposited in the permanent collections of the United States National Museum. The specimen from Saltpeter Cave will remain in the University of the South, at Sewanee, Tenn. In each case the bones belong to an associated skeleton. We have found two individuals, and we know exactly which bones belong to each, so ratios between different parts of the body can be studied with significance.

*Specimen No. 1 (U. S. N. M. No. 18262), from Salt River Cave.*—The skull and axial skeleton are less well represented than the appendages. There is a left half of the calvarium plus the left zygomatic arch. The right side of the specimen does not extend much beyond the sagittal crest, but includes most of the lambdoidal ridge. The ossicles are still in place in the left middle ear, though the arm of the malleus is broken off. Of the upper teeth only the right  $P^4$  is present and in good condition. There is a separate fragment of the left malar. Both lower canines and a tip of an upper are present, but the rest of the lower jaw, except for the left coronoid process, is missing. (See plate 16.)

There are very few good vertebrae. These include the third, fourth, and fifth lumbar, the sacrum, and 5 anterior caudals. In the pectoral appendage all bones are present on either the right side or the left, and for the most part they are in excellent condition. The scapula lacks about two-thirds of its glenoid or inferior border. The pelvic appendage is similarly complete, all parts being present on either the left or the right.

*Specimen No. 2, from Saltpeter Cave.*—In many respects this specimen is complementary to No. 1. The skull had been broken into some 70 pieces, but when reassembled it was much more extensive than the other. The rostral region in particular, which is totally missing in No. 1, is complete in No. 2 except for teeth. The only tooth of the upper jaw in good shape is  $P^3$ . The upper canines are present only in splinters, and the incisors are represented only by their roots. Particularly noteworthy is the absence of any indication of  $P^2$  on either side. Part of the paracone and the metacone of  $P^4$  are preserved on the right side, and the left  $M^1$  is complete. The lower jaw is in fairly good condition, though it, too, had to be reassembled from several

fragments.  $P_3$  is present on the right,  $M_1$  on the left, and the left lower canine is perfect. The incisors have all been broken off. The sagittal crest of the skull had been chewed away by rodents and had to be restored according to its dimensions in No. 1. Both occipital condyles and petrosal bones are present, and the left tympanic bulla and zygomatic arch are complete. As finally reconstructed the skull is sufficiently complete to allow all measurements referred to in this paper to be taken from the authentic parts without having to trust any "restorations."

All vertebrae are represented in No. 2 except the seventh lumbar, the sacrum, and the caudals. As for the pectoral appendage, only the humerus and the glenoid border of the left scapula are preserved. The pelvic appendage is complete on the left down to the middle of the ankle. There are no cuneiforms, metatarsals, or phalanges. Ribs exist only in numerous fragments.

Together these two finds include all parts of the skeleton except the intermediate and distal caudal vertebrae, the seventh lumbar vertebrae, the clavicles, the hyoid apparatus, the sternum, the crowns of the incisor teeth, the upper canines (present in No. 2, but splintered), and the second premolars of the upper jaw.

#### EXTENT OF PREVIOUS DISCOVERIES

In 1872 and 1873 Professor Leidy announced the discovery of a supposed new species of great Pleistocene cat, which he named *Felis augustus*. The type specimen was a left  $P^4$ , which had been collected by Hayden on the Niobrara River in Nebraska, and which Leidy declared to be "too large to have belonged either to the panther or the jaguar" and "too small to have belonged to the extinct American Lion, or *Felis atrox*." There was another tooth in this collection not figured or described by Leidy but since then attached by someone else to the fragment of maxilla in the type specimen where it obviously belongs, and these are now cataloged as specimen No. 125 in the United States National Museum.

Leidy also mentions and figures the distal end of a humerus collected by Hayden at the same time and place (though not definitely associated with the teeth) and assigns it tentatively to the same new species. (The humerus fragment is now U.S.N.M. No. 147.) This assignment is definitely a mistake. We have examined it carefully and are certain that it cannot have belonged to the same individual or species from which the teeth came. Now that we have associated skeletons of cats with teeth of approximately the same size, it is easy to see that the humerus fragment is altogether too large. Unfortunately it does not

include the parts that would make possible an easy and certain identification of species, but it can be only from one of two—*Smilodon californicus* or *Panthera atrox*, most likely the latter.

Another error in Leidy's paper, and one that has misled later authors, is his assignment of this material to the Pliocene (not Miocene as Simpson says), thus allowing them to overlook comparisons with Pleistocene cats. This is what happened in the next pertinent paper, in which O. P. Hay (1919) described and figured an upper left carnassial from the No. 2 bed at Vero, Fla. This he named *Felis veronis*, dismissing the possibility of its belonging to *Felis augustus* with the statement, "*Felis augustus*, besides belonging to the Arikaree of the Tertiary, differs in various ways from the Vero specimen." We have compared the two and are confident that Hay must have been convinced primarily by the supposed difference in stratigraphic horizons. The structural differences between the specimens are in features too variable in other cats to warrant serious consideration.

G. G. Simpson described (1929) several isolated teeth from Seminole Field, Fla., as belonging to *Felis veronis*. And in 1928 or 1929, while collecting at Melbourne, Fla., Dr. J. W. Gidley discovered a right lower jaw with canine and  $P_3$ - $M_1$ , two carnassials from different individuals, and one lower molar, all from cats of this same general range of dimension. He did not publish these finds, and only the lower jaw has ever been mentioned in the literature. This lower jaw (U.S.N.M. No. 11470) was described and figured by G. G. Simpson (1941b).

Drs. J. W. Gidley and C. L. Gazin (1938) described from Cumberland Cave, Md., a scapholunar, two calcanea, an astragalus, a second metacarpal, and third and fifth metatarsals, which they assigned to "*Felis* near *atrox*." Simpson examined them and concluded (1941b) that they belonged to some group distinct from jaguar, puma, or *atrox*, but that, "supposing all to represent a single species," they were more like puma than anything else.

It does not seem legitimate to lump these bones together as Simpson does in his figure 7.<sup>1</sup> The  $P^4$  included there was assigned by the original authors to the fossil puma *Felis inexpectata* and was never considered to belong to the same individual, or species, as the tarsal bones, for instance. It was separately cataloged as U.S.N.M. No. 11890 instead of U.S.N.M. No. 12840. Furthermore, even those cataloged together as U.S.N.M. No. 12840 clearly include at least two individuals, probably three, and probably two different species. The metatarsal III, scapholunar, two calcanea, and astragalus, are all distinctively jaguaroid and we would accept them as *Panthera augusta*, or, as the original authors said, "near *atrox*." But the two calcanea

<sup>1</sup> See footnote 3, last paragraph (p. 507).



are both lefts and therefore cannot possibly have belonged to one individual. The remaining two bones (metatarsal V and metacarpal II) we consider unquestionably puma.

In 1939 and 1940 J. Kyker and C. Hicks, employees in Craighead Caverns, near Sweetwater, Monroe County, Tenn., discovered footprints and several bones which G. G. Simpson (1941a) identified as jaguar. These bones, now in the American Museum of Natural History, include the right ramus of the lower jaw (A.M.N.H. No. 32633), lacking the incisors and the coronoid process and the medial portion of the articular condyle; the right side of the muzzle and cheek (A. M. N. H. No. 32635) with I<sup>1</sup>-I<sup>3</sup>, C, and P<sup>2</sup>-P<sup>3</sup>; the glenoid angle of the right scapula (A.M.N.H. No. 32638); and a left second metatarsal (A.M.N.H. No. 32637).

### DISCUSSION

Among fossil cats heretofore described and probably specifically distinct, the closest relationship to the new material is found in what Leidy (1852) originally defined as *Felis atrox*. He based this species upon a lower jaw fragment containing the canine, two premolars, and the molar. The type specimen belonged to the American Philosophical Society (now Academy of Natural Sciences of Philadelphia No. 12546), and it was unlabeled when Leidy studied it. He inferred that it probably came from Natchez, Miss., as it was kept with some fossils sent from that locality by William Henry Huntington. Its origin is thus not certainly known, and it is interesting that no other fossils definitely identified as belonging to the same species have since been found in the eastern part of North America.

A large number of disassociated bones of this species, now called *Panthera atrox*, came out of the famous asphalt pits at Rancho La Brea, Calif., and were elaborately studied by Merriam and Stock (1932) and compared with other species, ancient and modern. These authors concluded that *P. atrox* resembles the jaguar (*Panthera onca*) more closely than any other species and differs primarily in size, being the largest of all cats. They also decided that another species named by Leidy, *Felis imperialis*, which Freudenberg (1910) had called a giant jaguar, is synonymous with *P. atrox* and is based upon smaller individuals.

Simpson (1941) reaffirmed these affinities of *P. atrox* and *P. onca* and suggested a subgenus, *Jaguaris*, to indicate this relationship. He also decided that *Felis augustus* Leidy and *Felis veronis* Hay cannot be separated from each other or from *P. onca* by any reliable criteria of more than subspecific value. He therefore ascribed Leidy's material from Nebraska, Hay's from Florida, and his own from Tennessee to *Panthera (Jaguaris) onca augusta*.



It is to this material that ours is certainly most closely related. We began by calling our first specimen *P. atrox* because of the striking similarity of shape of all the parts. We recognized that it was small and, at first, thought it was possibly young and immature at the time of death. However, the removal of the rock from the surface of the bones, which permitted a clear view of the epiphyseal regions and sutures, and the discovery of a second individual settled the question of maturity. The epiphyses are completely united to the diaphyses, the sutures in the skull are in most regions wholly overgrown, and the tips of the canines and cusps of the premolars show wear. Both of these, then, were old and fully grown individuals and as such are definitely too small to be *P. atrox* unless there exists a small race of that species, a condition that has not thus far been proved.

In deciding whether they belong to any previously described form it is necessary to compare them with the parts that have been available, and from which the other types have been defined. Unfortunately, *P. augusta* and *P. veronis* were based solely upon upper carnassials, and so the investigation must begin there. Comparison of the type specimens with each other and with our material reveals minor morphological differences among the three in the proportion of width across the protocone to the greatest length of the tooth, in the shape of the cranial border, and in the development of the anteroexternal cuspule; but except for size the features of the type specimens can all be matched among contemporary jaguar teeth. The species *veronis* is invalid, then, as it cannot be separated from the previously described *augusta*; and if *augusta* is defined in terms of the upper carnassial alone, there is nothing to keep our material out of that category (species or subspecies as the case may be).

It is true that Leidy included in his description of the type of *P. augusta* a piece of humerus that did not belong there, but if we eliminate that, the definition of *P. augusta* is: a true cat having a  $P^4$  too large for panther or jaguar and too small for *P. atrox*. To the question, "Is this a valid type?" the answer must depend upon measurements and statistical analysis of the length of the  $P^4$  in the three fossils (*P. augusta*, *P. veronis*, and our specimen from Salt River Cave), and in *P. onca* and *P. atrox*, since the panther can be eliminated at once as altogether too small in that feature. The data are as follows:

The greatest length of the crown in the upper carnassial in our fossil is 31.2 mm. In the types of *P. augusta* and *P. veronis* this dimension, as we measure it, is 33.3 mm. (The measurements given by Simpson for these two types are slightly different, but their average is about the same as our figure.) The data for *Panthera onca* are

taken from table 1 of Nelson and Goldman<sup>2</sup> (1933) and table 102 of Merriam and Stock (1932). They are based upon 30 specimens, including adult males and females of all subspecies, located in the United States National Museum, the American Museum of Natural History, the Chicago Natural History Museum, and the Museum of Comparative Zoology. The combination of all these data shows a range of 23.4 mm. to 29.2 mm. with a mean of 26.6 mm. and a standard deviation of  $\pm 1.64$  mm.

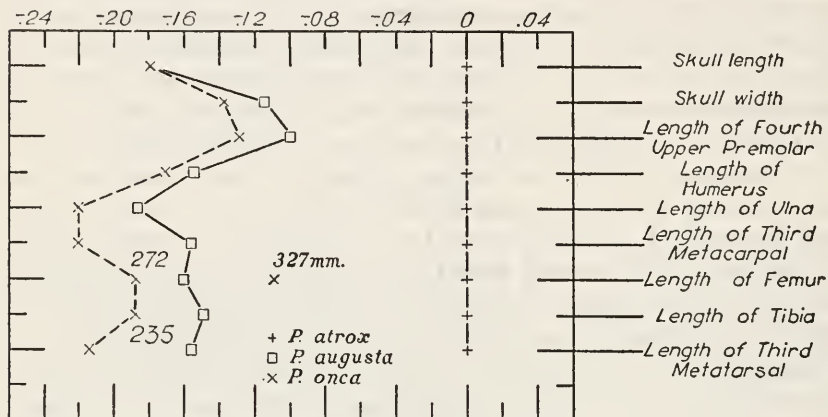


FIGURE 97.—Logarithmic-difference graph for the structures listed on the right, using *Panthera atrox* as the standard of reference and comparing it with *P. onca* and *P. augusta*. The numbers given refer to the actual dimensions in millimeters. The point marked 327 mm., which is not on any of the three curves, is discussed in footnote 4.

The deviation of our fossils is  $2.8\sigma$ , so that the odds against their belonging to any one of the contemporary subspecies of *P. onca* are 195 to 1. The odds against the types of *P. augusta* and *P. veronis* being simply exceptionally large jaguars of any subspecies still existing are more than 15,000 to 1. And finally, if no subspecies or species of cat other than the jaguars now surviving existed in Nebraska, Florida, and Tennessee in Pleistocene times, the chance of finding three with the dimensions of these fossils would be  $2 \times 10^{-11}$  percent. That is, the odds against it would be 5 trillion to 1! We are not,

<sup>2</sup> In the paper by Nelson and Goldman appears one anomalous measurement that we have tried to verify, but could not. An adult female of "*Felis onca paraguensis*," U.S.N.M. No. 4361, from Argentina (San José, Entre Ríos) is recorded as having an upper carnassial of 30.8 mm. length. This is strange for several reasons. It is more than 4 per cent bigger than the next largest record. It is from a female, which would be expected to be smaller than the largest males. And most important of all, it is from an animal not at all large in other dimensions. The skull, for instance, is recorded as measuring only 261 mm., in contrast to those from males of *P. paraguensis*, *P. milleri*, and *P. onca*, which run from 295 mm. to 302 mm. That a relatively small animal should have so disproportionately large a tooth seems too improbable to be accepted without careful confirmation. Unfortunately the specimen seems to have disappeared, and so we were not able to measure it. Of course, it is not certain that the measurement was inaccurate, but the odds against so large a departure from the mean are about 100 to 1; and for such a departure to occur in a relatively small animal seems almost incredible. We therefore suspect an error in the record.

therefore, justified in putting these three fossils into any of the contemporary subspecies of jaguar.

The chances of their belonging to *Panthera atrox*, while not quite so improbable, are also remote. The crown length of P<sup>4</sup> in *P. atrox* averages 39.4 mm. with a minimum of 35.0 mm., a maximum of 45.0 mm., and a standard deviation of  $\pm 2.43$  mm. The deviation of our fossils is  $3.37\sigma$ , which means that there is about one chance in 1,400

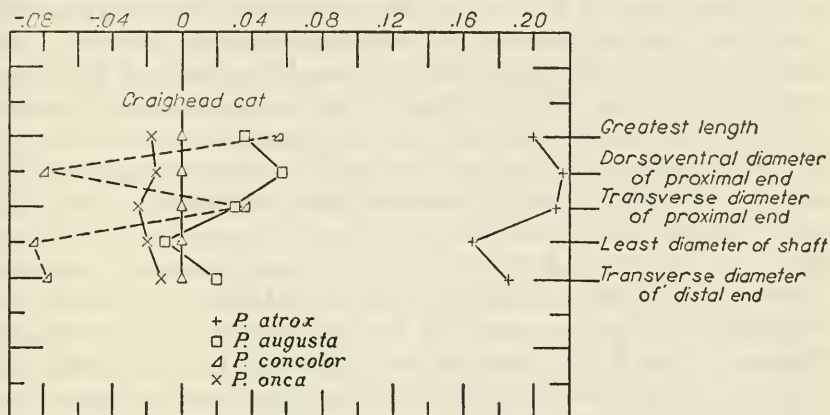


FIGURE 98.—Ratio graph for the second metatarsal, based upon Simpson's (1941b) figure 3, to which has been added the line for *Panthera augusta*.

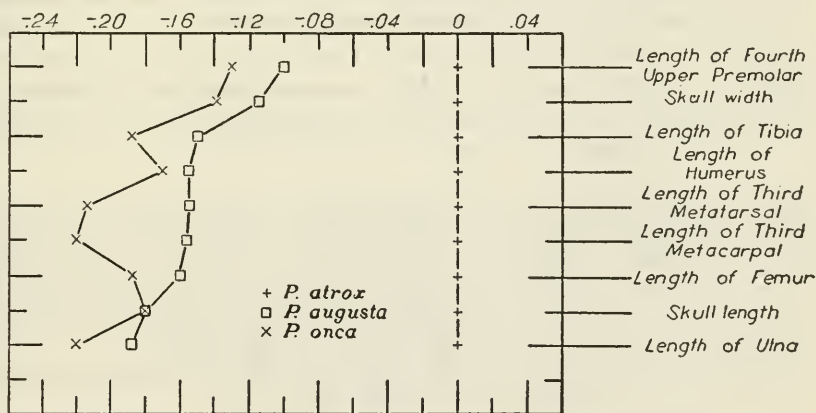


FIGURE 99.—Ratio graph based upon the same data as figure 97, but with the order of structures changed to make comparison of *Panthera atrox* and *P. augusta* clearer, with *P. atrox* still used as standard.

that they could be *P. atrox*. The other two (*P. augusta* and *P. veronis*) might occur as normal variations of *atrox* in about 1.23 percent of all cases, or against odds of 80 to 1. That three premolars of these dimensions would be found if *P. atrox* were the only form involved has an improbability of 10 million to 1.

It seems clear, then, that we are dealing with a different strain of cats, one that was intermediate between *P. atrox* and *P. onca*, and one that, for reasons of priority, should be called *P. augusta*.

It cannot be determined by a study of  $P^4$  alone whether our *P. augusta* was an independent species, or a subspecies of *P. onca* or of *P. atrox*. Even if good fortune should provide us with a large number of these intermediate cats, and the size of their premolars should overlap the range of *P. atrox* on the one side and of *P. onca* on the other (the above statistics are not concerned with this possibility and do not make it at all improbable), this would not indicate that they were all one species. The species *P. atrox* is characterized by many other consistent peculiarities of form, and enough specimens showing such features have already been assembled to make it clear that the species possessing this particular constellation of morphological characters was restricted in range of size of premolars within fairly clear limits. No specimen of *P. atrox* thus far found possesses premolars of the dimension of the one we have found, and the implication of the mathematics is that none existed that did possess such premolars. The same is true for all known races of *P. onca*. In other words, the probability is that a cat having a carnassial measuring from 31 to 34 mm. will be found to differ in other morphological features from *atrox* and *onca*.

To explore further this possibility we have constructed the graphs shown in figures 97 and 98, using Simpson's (1941b) convenient method of plotting logarithmic differences. The characteristics chosen for reference are those used both by Merriam and Stock in their table 98 for comparison of *P. atrox* and *P. spelaea* and by Simpson (1941b, fig. 10) for *P. atrox* and *P. onca*.<sup>3</sup>

<sup>3</sup> The virtue of this kind of graph is that it facilitates the comparison of relative proportions of different parts of the body in different animals. If the proportions of *P. atrox* be taken as the standard for comparison, as in figure 97, the base or zero line represents these, and is straight. Another animal with the same relative proportions would appear on the graph as another straight line, to the left if smaller in all parts, to the right if larger in all parts. A crooked line represents an animal with different proportions, irrespective of the actual dimension of any of the parts. These dimensions may, of course, be calculated if such data as those in the next paragraph are provided.

The base line in figure 97 represents the average values for all the measurements listed on the right. As given in Merriam and Stock they are:

Structure	Millimeters
Condylabasal length of skull.....	353.0
Bizygomatic breadth of skull.....	250.4
Length of $P^4$ .....	39.4
Length of humerus.....	368.5
Length of ulna.....	416.0
Length of third metacarpal.....	126.6
Length of femur.....	421.3
Length of tibia.....	361.7
Length of third metatarsal.....	146.1

Such dimensions, which determine the zero line, should always be recorded in connection with any such graph, as they enable the reader both to compute any other dimensions indicated, and to add to the graph additional lines representing other material for comparison.



Examination of figure 97 shows that our fossils, while smaller, resemble *P. atrox* in the proportions of the humerus, third metacarpal, femur, tibia, and third metatarsal—in other words, in most of the limb proportions. The skull is relatively broader and the  $P^4$  proportionately much larger. The length of the skull and the length of the ulna are reduced in about the same degree, having approximately the same relation to each other as in *atrox*, but being smaller in proportion to the other parts of the body.

The Recent jaguar skeleton used for comparison in these figures (U.S.N.M. No. 49393) was chosen for its large size and is therefore not typical in total dimension, but it is presumably normal in the relative proportions of interest here. It has a skull as long as that of our Saltpeter Cave fossil (our specimen No. 2), but all other parts of the skeleton are smaller. The reduction is most conspicuous in the metapodials, which are proportionately shorter than in either of the fossil forms.<sup>4</sup>

The metapodials of these cats are equally distinctive in features other than length. Figure 98 shows Simpson's original ratio diagram comparing the second metatarsal in *P. concolor*, *P. onca*, *P. atrox*, and the fossil jaguar from Sweetwater, Tenn. (see Simpson, 1941b, p. 6, fig. 3), with one line added to represent our new material. It will be seen that although Simpson's jaguar fossil was quite similar to the Recent jaguar, ours differs from it in relative proportions as much as does *P. atrox*, and in a rather similar way; so that ours resembles

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Regarding the interpretation of the graph, it should be noted that relative proportions within the body of any one species (any one line on the graph) are not directly indicated, but only how these relative proportions compare with those of the standard of reference. Thus, if the maximum width of the head is shown displaced to the right and the length of the ulnar to the left, this does not mean that the diameter of the head is greater than the length of the forearm. It means that the head is broader in proportion to other parts of the body in *P. onca* than it is in *P. atrox*. Similarly, if the length of  $P^4$  is displaced farther to the right than is the skull width, it does not mean that the length of this tooth is greater than the width of the skull, but that it is proportionately more enlarged in *P. onca* than is the width of the skull, when both of these are compared with the corresponding proportions in *P. atrox*. This is a tremendously valuable kind of information and it is better exhibited by this means than by any other we know.

It should be noted also that the usefulness of ratio diagrams is completely destroyed when isolated bones from different individuals are mixed together. To have any significance at all, each curve in the graph must represent parts of a single individual, or of two or more individuals definitely known to be of the same species and size, or well established averages for parts of a single species.

<sup>4</sup>One measurement indicated in Simpson's figure 10 is surprising. Though no actual dimensions are given in the figure, the base line is said to be taken from Merriam and Stock. The average length of the femur in *P. atrox* as given by these authors (1932, p. 190) is 421.3 mm. On this scale the femur length indicated for *P. onca* would have to be about 327 mm. We have not seen a jaguar femur anywhere near that size. The largest we have measured is 272 mm. This was from a very large but not maximal specimen. If the same proportions exist in the largest, the femur should not exceed about 282 mm. If we had used Simpson's figure we should have had to claim another distinction between *P. onca* on the one hand and *P. atrox* and *P. augusta* on the other, but the curve was left as found from our own measurements.

*P. atrox* more than it does *P. onca*. None of these is at all similar to the puma, so we have not included *concolor* in other figures.<sup>5</sup>

One of the features in which *P. augusta* is most dissimilar to modern jaguars is the ratio of width of muzzle to condylobasal length of skull.

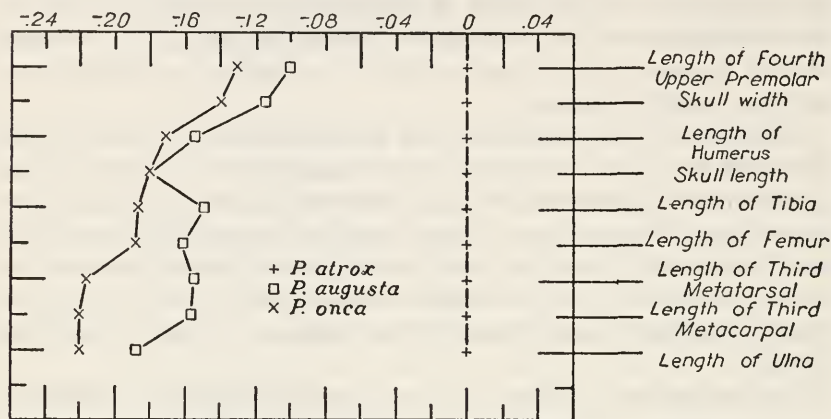


FIGURE 100.—Ratio graph with the order of structures changed to facilitate comparison of *Panthera atrox* and *P. onca*.

In our Saltpeter Cave fossil this ratio has the value 0.347. In a series of jaguars in the United States National Museum it varies from 0.297 to 0.324 with an average value of 0.309 and a standard deviation of  $\pm 0.008$ . The departure of the ratio in the fossil from the mean for the modern jaguar is  $4.75\sigma$ . The odds against such a variation occurring in any known subspecies of jaguar are considerably greater than 15,000 to 1. On the other hand, *P. augusta* and *P. atrox* resemble each other sufficiently closely in this ratio to be inseparable by reference to it. *P. atrox* averages only  $0.328 \pm 0.0129$ . The *P. augusta* specimen shows a deviation of 0.019, which is only about 1.46 times the standard error and cannot be taken seriously.

Furthermore, *P. augusta* is sharply distinct from *P. onca* in several other features not previously mentioned, and in these it resembles *P. atrox* so closely as to be inseparable with reference to them. Thus, the inflation of the frontal region in *P. augusta* and *P. atrox* is quite

<sup>5</sup> The Sweetwater material, however, is not all from one individual. The teeth will not occlude properly. The lower jaw is decidedly too big for the upper jaw. So at least two individuals are involved, and possibly more. Presumably the mandible belongs to the same species as do our fossils, but we are not at all sure about the second metatarsal. Since the Sweetwater bones are quite definitely not from one individual, there is no compelling *a priori* reason for accepting them as one species. We shall not pursue this puzzle any further in the absence of more material, but the possibility should be borne in mind that there may have existed in Pleistocene times both a true jaguar with the shortened and characteristic metapodials, and another cat, *P. augusta*, which was more like *P. atrox* in these and several other parts, but only slightly larger than *P. onca*. More associated skeletons will be needed to settle this point.

conspicuous in contrast to that of *onca*. This shows up in the inter-orbital distance, in the maximal width of the frontals at their zygomatic (or postorbital) processes, and in the minimal diameter of the frontal region. In *P. augusta* and *P. atrox* all these dimensions are

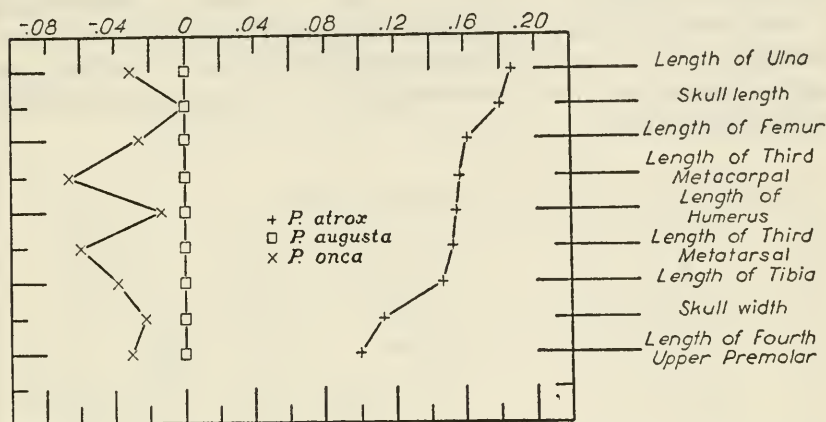


FIGURE 101.—Ratio graph with *Panthera augusta* as standard and structures listed so as to emphasize resemblances between *P. augusta* and *P. atrox*. The dimensions for the zero line are:

Structure	Millimeters
Length of ulna.....	270.0
Condylbasal length of skull.....	233.0
Length of femur.....	291.0
Length of third metacarpal.....	88.0
Length of humerus.....	257.5
Length of third metatarsal.....	102.2
Length of tibia.....	257.0
Bizygomatic breadth of skull.....	191.6
Crown length of P <sup>4</sup> .....	31.2

much greater in proportion to the condylbasal length of skull than they are in *P. onca*. For instance, the condylbasal length in *P. augusta* is only about 4.07 times the interorbital distance—in contrast to about 5.05 times for *P. onca*. Similarly, the proportions of the calcaneum are just about identical in *P. augusta* and *P. atrox*, and quite different in *P. onca*, where this bone is not only proportionately shorter but has a much elongated medial astragalar facet.

We thus find our *P. augusta* intermediate in many respects between its contemporary, *P. atrox*, and the modern jaguar, *P. onca*. It is nearer *P. onca* in size, in breadth of skull at the zygomatic region, and in shortness of the ulna; but it is nearer *P. atrox* in the proportionate length of the metacarpals and metatarsals, in the relative lengths of all the limb bones except the ulna, in the relative breadth of the muzzle and frontal region, and in the proportions of the calcaneum.

It is distinct from each in having proportionately the shortest skull and the largest  $P^4$ . All three are certainly related cats within the subgenus *Jaguaris*.

Clearly *P. onca* and *P. atrox* are considerably different creatures, and while it is difficult to decide whether *P. augusta* is closer kin to *P. onca* or to *P. atrox*, it is likewise clear that *P. augusta* is an intermediate form with more or less equivalent degrees of similarity to each in different ways, as is demonstrated by the ratio graphs in figures 99, 100, 101, and 102.

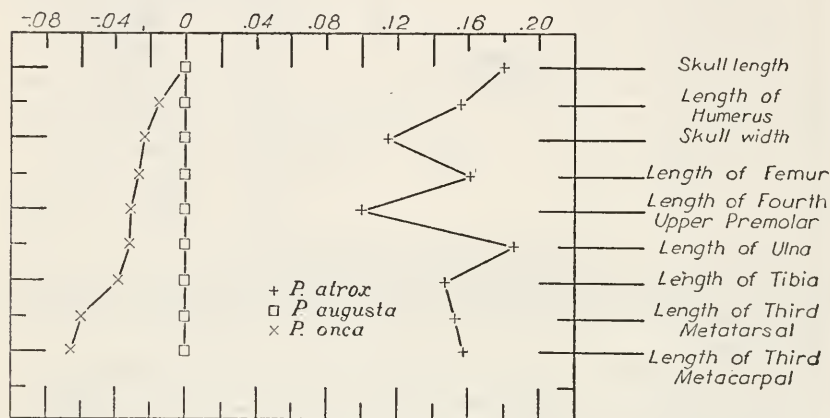


FIGURE 102.—Ratio graph with *Panthera augusta* as standard and structures listed so as to emphasize resemblances between *P. augusta* and *P. onca*.

Historically the concept of species was first applied to organisms at one chronological horizon, and in that context its implications are fairly clear. *P. atrox* and *P. augusta* were contemporary, and statistical data for *P. atrox* are sufficient to show that the species did not include the variations exhibited by *P. augusta*. These two, then, are separate species. They did not intergrade during the late Pleistocene. And if, as seems to be the case, the modern jaguars are at least as different from the fossil *P. augusta* as the latter was from *P. atrox*, then the only practical usage seems to be to recognize all three as separate and valid species.

We have decided, therefore, to call our specimens from Little Salt River and Saltpeter Caves *Panthera (Jaguaris) augusta*, and to include in this classification Leidy's "*Felis augustus*," Hay's "*Felis veronis*," Simpson's "*Panthera (Jaguaris) onca augusta*" (with the possible exception of the second metacarpal), and probably some of the Cumberland Cave specimens (with the reservations noted on pages 501 and 502).



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PANTHERA AUGUSTA (LEIDY), U.S.N.M. NO. 18262







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## AN ANNOTATED CHECKLIST OF THE MOSQUITOES OF THE SUBGENUS *FINLAYA*, GENUS *AEDES*

By KENNETH L. KNIGHT and ELIZABETH N. MARKS

SINCE the appearance of Edwards' (1932) volume of the *Genera Insectorum* on the family Culicidae, the list of valid species, subspecies, and varieties belonging to the subgenus *Finlaya* has been increased from 101 to 165. Furthermore, many life-history stages formerly unknown have since been described. Because of this great increase in knowledge, it has been thought worth while at this time to bring Edwards' checklist up to date for this subgenus.

The scope of this list is somewhat different from that of Edwards' (1932). First, the exact original citation of the scientific name is given; second, the location of the type material and the type-locality data are presented; third, a generalized statement of the larval habitat is included; fourth, except for the original citation, the only literature references given are those that most adequately describe the stages not included in the type description; fifth, subgroups are erected and keys to both the groups and subgroups<sup>1</sup> are presented.

The systematic categories of "group" and "subgroup" are used in this paper in the same sense that "genus" and "subgenus" are used by mosquito systematists, namely, as further subdivisions of apparently related species. Aside from the convenience of having these

<sup>1</sup> In contrast to the current system of terming as "series" all combinations below the group level, we have employed the expression "subgroup." This has been done because of its uniformity with the existing terminology of "family-subfamily" and "genus-subgenus."

additional lower categories, which is considerable where large numbers of species are involved, they have a real value in delineating relationships.

As is to be expected some of the groups and subgroups are more natural than others. For example, Groups A and E show so little divergence as to suggest that they have not developed far beyond the superspecies stage. On the other hand, Groups F and H are sufficiently heterogeneous to suggest that they probably include even unrelated species. No effort has been made to make the groups more natural by increasing their number, because of the impairment this effects on their value as taxonomic aids. In contrast to this, every effort has been made to keep the subgroups as natural as possible, regardless of how many separate units this would make necessary. As a result, it is in this category that polytypic species and superspecies may best be looked for.

Although group names have no true nomenclatorial standing, it is felt wise for the sake of simplicity to utilize previously published names where available. Consequently, except for certain necessary minor modifications, Edwards' (1932) system of group nomenclature has been employed here. The subgroup nomenclature is new with us.

Although it is felt that the term "variety" has little desirability for use in the Culicidae, varietal status has been maintained for those names designed as such in the original citations, except in the few cases where additional work has been done and they have been shown to be either full species or valid subspecies.

The keys given in the following pages are all to the adult stage only. Although many of the subgroups are distinct on larval characters, it has not been found possible as yet to write subgroup keys based on the larvae.

Where satisfactory group and subgroup revisions or treatments exist, a reference is made to them only in the discussion of the division in question and is not repeated under each involved species. Where such are not available or where additional life-history stages have since been described, the reference is listed under the individual species.

We wish to acknowledge gratefully the cooperation of the following people who made it possible for us to see the types of many of the species treated in this paper: P. F. Mattingly, British Museum; Alan Stone, Bureau of Entomology and Plant Quarantine, United States Department of Agriculture; Mrs. J. Bonne-Wepster, Institute of Tropical Hygiene, Amsterdam; D. J. Lee, University of Sydney; and H. W. Kumm, Rockefeller Foundation, Rio de Janeiro. Many others confirmed by letters the presence or absence of types in their collections and to them we are most grateful.

## Genus AEDES Meigen

## Subgenus FINLAYA Theobald

- Finlaya* THEOBALD, Monograph of the Culicidae or mosquitoes, vol. 3, p. 281, 1903. (Type, *poicilia* Theobald.)
- Finlayia* GILES (error), Journ. Trop. Med. vol. 7, p. 366, 1904. (Type, *poicilia* Theobald.)
- Gualteria* LUTZ, Mosquitos do Brasil, p. 47, 1904. (Type, *oswaldi* Lutz.)
- Danielsia* THEOBALD, Entom., vol. 37, p. 78, 1904. (Type, *albotuaniata* Leicester.)
- Hulecoctomyia* THEOBALD, Entom. vol. 37, p. 163, 1904. (Type, *trilineata* Leicester.)
- Popea* LUDLOW, Can. Ent. vol. 37, p. 95, 1905. (Type, *lutea* Ludlow.)
- Phagomyia* THEOBALD, Genera insectorum, family Culicidae, p. 21, 1905. (Type *gubernatoris* Giles.)
- Lepidotomyia* THEOBALD, Genera insectorum, family Culicidae, p. 22, 1905. (Type, *magna* Theobald.)
- Gymnotetopa* COQUILLETT, Proc. Ent. Soc. Washington, vol. 7, p. 183, 1906. (Type, *mediovittata* Coquillett.)
- Protomacleaya* THEOBALD, Monograph of the Culicidae or mosquitoes, vol. 4, p. 253, 1907. (Type, *triseriatus* Say.)
- Pseudocarrollia* THEOBALD, Rec. Indian Mus. vol. 4, p. 13, 1910. (Type, *lophoventralis* Theobald.)
- Molpemyia* THEOBALD, Monograph of the Culicidae or mosquitoes, vol. 5, p. 479, 1910. (Type, *purpurea* Theobald.)
- Calomyia* TAYLOR, Trans. Ent. Soc. London 1913, p. 684, 1914. (Type, *priestleyi* Taylor.)
- Conopostegus* DYAR, Insector Inscitiae Menstruus, vol. 13, p. 143, 1925. (Type, *leucoclaenus* Dyar.)

*Adult*.—Palpi of male at least half as long as proboscis, rarely exceeding it in length; last two segments usually more or less swollen and hairy, but sometimes quite slender and bare. Palpi of female variable in length, ranging from about one-eighth as long as the proboscis (*lacteus* Knight) to fully two-thirds as long (*fulgens* (Edwards)). Proboscis slender, usually longer than front femora. Antennae of male with plume hairs directed mostly dorsally and ventrally. Vertex dorsum and scutellum narrow- or broad-scaled, or with intermediate conditions occurring. Acrostichal and/or dorso-central bristles present or absent, a few prescutellar bristles always present. Paratergite with or without scales. No lower mesepimeral bristles. Fore- and mid-tarsal claws toothed in both sexes, in male the larger claws usually bidentate (unidentate in *stonei* Knight and Laffoon); hind claws simple in both sexes. *Genitalia*: MALE: Basistyle with apical lobe absent; basal lobe usually absent but occasionally weakly formed, or rarely even distinct (*harperi* Knight and *leucotaeniatus* Komp, for example). Dististyle simple, appendage apical. Mesostome simple and undivided. Claspettes present (with a peculiar basotergal lobe in *aureostriatus* (Doleschall) and its related

species) and with a distinct apical articulated appendage or filament (reduced to a bristle in *dissimilis* (Leicester) and its related species). FEMALE: Eighth abdominal segment rather large, only slightly retractile (basal membrane of eighth segment less than 0.4 as long as eighth sternite); eighth sternite large and usually at least somewhat compressed laterally. Cerci short. Postgenital plate reaching 0.6 or more of distance to the apex of the cerci.

*Larva*.—Extremely varied, but usually having in common the following few characteristics: Siphon almost always with an acus at level of pecten teeth. Anal plate without acus, always incomplete, nearly always with spines or spicules on posterior lateral margin. Ventral brush usually with 8–12 tufts, usually borne on a sclerotized, barred area. Habitat primarily of three types: a, The water-holding spaces of living plants; b, tree holes and bamboo stumps; and c, rock holes in stream beds. A few species breed in the water collected in fallen leaves and other water-holding plant remains. A number of species have been found occasionally in artificial containers. *A. togoi* (Theobald) is found commonly in brackish rock pools along sea-coasts. *A. alboannulatus* (Macquart) and *A. occidentalis* (Skuse) have been reported from brackish marshes.

*Distribution*.—This very large subgenus has a world-wide distribution, being absent only from the northern rim of the Holarctic region. However, it has attained its greatest development in the Oriental region.

*Relationships*.—Morphologically this subgenus is most closely related to the subgenus *Ochlerotatus* (and quite probably derived from a common stock), the only essential differences being the absence of a distinct basal lobe on the basistyle in most species, and the shortness of the cerci and of the basal membrane of the eighth abdominal segment in the female. Also, the subgenus in general is more highly ornamented than is *Ochlerotatus*, and the larvae are found only rarely in ground pools (as are the larvae of nearly all the species of *Ochlerotatus*). As yet the larval morphology is known adequately for too few species to permit a decision as to whether valid separation characters exist in that stage. As is to be expected, some aedine species occur that are annectant between these two subgenera, and it will not be possible to settle the position of these definitely until much more morphological and biological data are available for them.

The Neotropical subgenus *Howardina* Theobald is also closely related to *Finlaya*, differing from it according to Edwards (1932) only in the simple claws of the female, the less prominent eighth sternite of the female abdomen, and the less developed claspettes of the male genitalia. However, in this last respect the species



included in *Howardina* show no difference at all from *A. (Finlaya) dissimilis* (Leicester) and its related species.

One other marked relationship needs to be mentioned and that is with the genus *Haemagogus* Williston. According to Edwards (1932) this genus probably represents a development from the subgenus *Finlaya* through some such species as *A. (F.) leucocelaenus* Dyar and Shannon.

Vargas (1949) has recently revived the name *Gualteria* Lutz for all the New World species that are at present included in *Finlaya*. In the absence of the evidence for this step, which is to appear in a later paper of his, it cannot be discussed at present.

The species *jacobinae* Serafim and Lutz, *milleri* Dyar, and *varipalpus* (Coquillett) are excluded here from the subgenus *Finlaya* on the basis of female genitalic characters. The species *littlechildi* Taylor is believed to be a *Macleaya* and so is also excluded. The name *pulcherrimus* (Taylor) is a synonym of *aegypti* (Linnaeus) and has accordingly been omitted. Natvig (1948) has examined male types of *fuscus* Zetterstedt and found them to be *Aedes (Ochlerotatus) punctor* (Kirby). Consequently, the names *fuscus* Zetterstedt and *wahlgreni* Theobald have been removed from *Finlaya*. The position of *upatensis* Anduze and Hecht in *Finlaya* appears somewhat doubtful, but since no material has been seen it is included for the time being.

*Systematics.*—On the basis of ornamentation Edwards (1932) divided the subgenus *Finlaya* into eight groups, to which he applied the following vernacular names: Group A (kochi-group: *Finlaya*, s. str.), Group B (terrens-gubernatoris-group: *Gualteria*), Group C (longipalpis-group), Group D (chrysolineata-group: *Hulecoetomyia*), Group E (mediovittata-group: *Gymnometopa*), Group F (albotaeniata-group: *Danielsia*), Group G, and Group H.

The following changes have been made in the groups proposed by Edwards: Group G was found to be too poorly defined to be maintained and has been coalesced with Group D. In order to avoid confusion the alphabetical designations of the groups were not shifted following the removal of Group G. The word "gubernatoris" was omitted from the name of Group B for the sake of conciseness. In conformance with the policy commonly employed by Edwards (1932) of using the oldest included species name for the group title, "chrysolineata" of Group D has been replaced by "aureostriatus," "albotaeniata" of Group F by "alboannulatus," and the name "geniculatus" linked for the first time with Group H. For further identification Edwards followed the practice of linking the oldest available subgeneric name to each group title. The only change made by us in this respect has been to add the term "Protomacleaya" to the title for

Group H. Edwards italicized any scientific names appearing in the group titles, but since these titles are vernacular in nature, this policy has not been followed here. In addition to the above, many species have been removed to other groups.

The greatest difficulty has been encountered in defining the groups so that the definitions would be sufficiently diagnostic to permit the preparation of a key, and it is quite plain that the results obtained have not been successful in all cases.

For example, the Madagascar species *monetus* Edwards and *phillipi* van Someren, while unquestionably related to the other members of Group C, break down the group definition in the possession of all dark hind tarsi and will normally key to Group H (where on the basis of scutal pattern we find *monetus* amazingly similar to *leucocelaenus* Dyar and Shannon and *leucotaeniatus* Komp). This striking parallel development of similar ornamentation patterns in species from different groups and different geographical regions suggests that the potentiality for the development of at least some of such characters is inherent within the subgenus as a whole rather than within any particular group.

Another type of problem encountered in defining and keying the groups is illustrated by such a species as *quasirubithorax* (Theobald). This species usually possesses a linear scutal marking pattern and on the basis of this and other characters appears to belong to Group D. However, in some specimens this scutal pattern either may be obliterated by general pale scaling or it may be absent altogether; as a result such specimens key to Group F.

The policy followed with marginal species has been to include them in the group to which they appear to be most closely related on over-all general appearance.

The question has been raised of whether or not the groups of *Finlaya* could be considered subgenera if *Finlaya* were to be given generic rank once again. It is true that names are already available for all but Group C, and that in almost all cases one has no difficulty in recognizing the group to which a species belongs; yet a serious handicap to such a plan lies in the fact that all the groups are erected on ornamentation characters solely, and consequently, in many cases, unrelated species are included. Additional and more relevant arguments for the retention of the larger generic concept have been aptly phrased by Edwards (1932) as follows: "The advantages of employing larger generic concepts are, firstly, that the wider relationships of the species are more clearly indicated; secondly, that limits can more readily be assigned to the genera than in the case of more numerous and smaller groups; and, thirdly, that it ensures the avoidance of duplication of specific names; the use of subgeneric terms enables those who wish to do so to make use of the smaller divisions."

## KEY TO THE GROUPS OF THE SUBGENUS FINLAYA

1. Wings profusely spotted with areas of pale and dark scaling; femora and tibiae spotted and ringed with pale scaling for nearly their whole length.  
GROUP A (*kochi*-group) (p. 519)  
Wings not spotted;<sup>2</sup> femora and tibiae not spotted and ringed with pale scaling for nearly their whole length..... 2
2. Hind tarsi with a broad white band at base of II, usually also a narrower ring at base of I, remainder of segments dark, or V all white except possibly for one side<sup>3</sup> (III basally banded in *embuensis*); Ethiopian and Madagascar species..... GROUP C (*longipalpis*-group) (p. 525)  
Hind tarsi not marked as described above..... 3
3. Hind tarsi all dark scaled..... GROUP H (*geniculatus*-group) (p. 539)  
Hind tarsi with pale markings..... 4
4. Scutal pattern consisting of a pattern of narrow longitudinal lines of white to yellow scales (in addition, there may be 1 or 3 small pale areas on anterior margin, a patch on posterior margin of anterior fossa, and a small patch before wing base)..... 5  
Scutal markings various in type, or absent, but not consisting largely of a pattern of narrow longitudinal pale lines<sup>4</sup>..... 6
5. At least the mid-femora, and usually also one or more of the tibiae, lined anteriorly with pale scales for nearly their whole length, occasionally femoral line broken and no anterior pale tibial line present.  
GROUP E (*mediovittatus*-group) (p. 530)  
Femora and tibiae not lined anteriorly with pale scales for nearly their whole length..... GROUP D (*aureostriatus*-group)<sup>5</sup> (p. 526)
6. Hind tarsi with a basal and apical band on I (rarely no basal pale scales on I), a basal band on II (this usually about equal in size to the apical marking on I), sometimes pale scaling is present over joint between II and III or else just a few basal pale scales on III, IV and V usually all dark but in a few species possessing pale markings; in Subgroup IV the hind tarsi are dark except for a basal band on I..... GROUP B (*terrens*-group) (p. 521)  
Hind tarsi with basal bands on at least the first three segments (if only on the first two then no apical bands present); sometimes one or more segments with a small amount of apical pale scaling but not with definite bands..... GROUP F (*alboannulatus*-group) (p. 532)

## Group A (KOCHI-group: FINLAYA, s. str.)

Australasian and Oriental species. Wings profusely spotted with areas of pale and dark scaling. Scutum with a definite or indefinite variegated pattern of dark and pale scales. Femora and tibiae spotted and ringed with pale scaling for nearly their whole length. Hind tarsi variously banded or marked with pale scales.

<sup>2</sup> May be a small basal area of pale scaling however. Also, *monocellatus* and *biocellatus* of Subgroup VIII Group F, have one and two large anterior areas of pale scales respectively.

<sup>3</sup> The Madagascar species *monetus* and *phillipi*, although obviously members of Group C, key to Group H because of the all-dark hind tarsi.

<sup>4</sup> The Oriental species *olboteniatu* var. *mikiranu* has three indistinct pale lines on the scutum, but also possesses a large white area before the wing base.

<sup>5</sup> Some individuals of a few species of Subgroups IV, V, and VI of Group D will key to Group F owing to the linear scutal pattern being obscured by general pale scaling, or to its becoming obsolete altogether. Some individuals of *quasirubithorax* have a fairly definite anterior line on the midtibia and a less definite line on midfemur and thus would key to Group E.





## Subgroup III, GANI

*Definition.*—Basistyle without an inner median tuft of scales. Claspette filament bristlelike. Scales of *ppn* narrow. Sternites without outstanding scales apically.

*Included species.*—*A. gani* Bonne-Wepster.

## Group B (TERRENS-group: GUALTERIA)

Australasian, Oriental, Palaearctic, Nearctic, and Neotropical species. Wings not spotted with areas of pale scaling. Scutum with an area of pale scales anteriorly (greatly reduced and fragmented in *unicinctus*), frequently divided longitudinally down the middle by a dark scaled area, a pale scaled area before the wing base (either separate from or coalesced with the anterior pale area). Femora and tibiae not spotted and ringed, nor lined anteriorly with pale scales for nearly their whole length. Hind tarsi with a basal and an apical band on I (rarely no basal pale scales on I), a basal band on II (this usually about equal in size to the apical marking on I); sometimes pale scaling is present over the joint between II–III or else just a few basal pale scales on III, IV and V usually all dark but in a very few species possessing pale markings; *unicinctus* offers a marked exception to the above in having the hind tarsi dark except for a basal band on I.

In addition this group is characterized by having the general coloring black and white (not true of Subgroup VII); the mid- and hind-femora with apical pale scaling anteriorly; larval head hairs 5 and 6 in a longitudinal line, hair 6 anterior to the level of 7; and the comb scales numerous and in a patch (linear in *lophoventralis*). The larvae of *cacharanus*, *cogilli*, *inquinatus*, *thorntoni*, and *tsiliensis* are not described. The larvae are usually found in tree holes, less frequently in bamboos, and occasionally even in artificial containers in wooded areas.

As Edwards (1932) has pointed out, this group has a remarkably discontinuous distribution, and yet there seems to be no doubt that the Neotropical species are closely related to those of the Oriental region (sparsely represented in the adjoining parts of the Australasian and Palaearctic regions).

The inclusion of *seoulensis* in Group B is undoubtedly open to question, since both the adult and larva differ in several respects from all the others; yet in general habitus it seems to belong here.

Since the male of *thorntoni* Dyar and Knab is unknown at present, it is impossible to determine whether it belongs in Subgroup I or II.

## KEY TO THE SUBGROUPS OF GROUP B (TERRENS-GROUP)

1. Hind tarsi dark except for a basal white band on I.  

SUBGROUP V, *unicinctus* (p. 524)

Hind tarsi with additional markings..... 2
2. Postspiracular area scaled; hind tarsi with basal and apical bands on I-IV, V usually all white.....SUBGROUP VII, *atropalpus* (p. 525)  
Postspiracular area without scales; hind tarsi without the above combination of markings..... 3
3. Scutum with an anterior area of pale scales, this sometimes divided partially or completely in the middle, a separate pale patch before wing base (if coalesced with the anterior patch then of a different shade of color); fore tibiae with an anterior dorsal white area at, or near, the apex..... 4  
Not with the above combination of characters..... 5
4. *Ppn* with narrow scales only; basistyle with a prominent inner median tuft of scales.....SUBGROUP IV, *tsiliensis* (p. 524)  
*Ppn* with broad scales, or bare; basistyle without a tuft of specialized scales.  

SUBGROUP III, *gubernatoris* (p. 523)
5. Hind tarsi with basal bands on I-III, narrow apical bands on I-II, a few pale scales may be present basally on IV....SUBGROUP VI, *seoulensis* (p. 524)  
Hind tarsi with basal bands on I-II, an apical band on I..... 6
6. Male palpi with numerous long hairs arising apically on III and all along IV, some also present on V, palpi not distinctly shorter than proboscis; claspette filament of male genitalia cylindrical, narrow in lateral view.  

SUBGROUP I, *terrens* (p. 522)

Male palpi with only a few short stiff setae on last two segments, palpi only about two-thirds length of proboscis; claspette filament of male genitalia broadly expanded in lateral view....SUBGROUP II, *argyrothorax* (p. 523)

## Subgroup I, TERRENS, s. str.

*Definition.*—Neotropical species. Male palpi with numerous long hairs arising apically on III and all along IV, some also present on V. Basistyle without a specialized scale tuft. Claspette filament cylindrical, curved, bladelike in lateral view. Scutum with a large anterior area of pale scales, this frequently being partially or completely divided medially by a dark scaled area, the anterior area of pale scales not separate from (rarely very narrowly so), nor of a different color from, the patch of pale scales before the wing base. *Ppn* completely covered with broad pale scales. Postspiracular scales absent. Fore tibiae without an anterior white patch at or near the apex. Hind tarsi with base and apex of I and the base of II banded with pale scales, the apical band on I frequently being as broad or broader than the basal band on II (base of I dark or with only a few pale scales in type series of *podographicus*).

*Supplementary characters.*—Vertex dorsum with at least narrow scales along the longitudinal midline. Preala scaled below knob. Subspiracular scale patch present (none in males of type series of *podographicus*). Some of the sternites with outstanding or roughened scales apically.

*Included species.*—*A. terrens* (Walker), *t. var. metoecopus* Dyar, and *t. var. podographicus* Dyar and Knab.

*Discussion.*—A rather comprehensive treatment of this subgroup may be found in Dyar (1928). However, as it stands at present Subgroup I is badly in need of some additional study.

#### Subgroup II, ARGYROTHORAX

*Definition.*—As in Subgroup I except: Male palpi with only a few short stiff setae on last two segments, the palpi themselves being only about two-thirds as long as proboscis; claspette filament broadly expanded in lateral view; and vertex dorsum broad scaled (except possibly on the ocular margin and nape).

*Included species.*—*A. argyrothorax* Bonne-Wepster and Bonne.

#### Subgroup III, GUBERNATORIS

*Definition.*—Oriental, with representatives in the Australasian and Palaearctic regions. Male palpi and basistyle as in Subgroup I (male of *watasei* is not described). Claspette filament curved, bladelike in lateral view. Scutum with a large anterior area of pale scales, this sometimes divided partially or completely in the middle; a separate patch of pale scales before wing base (coalesced with anterior pale area in the male of *inquinatus* but of a different shade of color). *Ppn* with a patch of broad scales, sometimes bare, when scaled the scales not covering area completely. Postspiracular scales absent. Fore tibiae with a dorsal white area near or at apex (only slightly pale in *inquinatus*). Hind tarsi with a basal and an apical band or spot on I, a basal band or spot on II (usually about equal to the apical marking on I), sometimes there is pale scaling over the joint between II–III or else a few pale scales basally on III.

*Supplementary characters.*—Vertex dorsum all broad scaled medially (may be narrow scales on ocular margin and nape, however). Prealar scale patch present or absent. Subspiracular area unscaled. Some of the sternites with outstanding or roughened scales apically.

*Included species.*—*A. assamensis* (Theobald), *cacharanus* (Barraud), *cogilli* Edwards, *deccanus* (Barraud), *feegradei* Barraud, *gubernatoris* (Giles), *g. var. kotiensis* Barraud, *inquinatus* Edwards, *kazani* Edwards, *lophoventralis* (Theobald), *melanopterus* (Giles), *plumiferus* King and Hoogstraal, *prominens* (Barraud), and *watasei* Yamada.

*Discussion.*—This subgroup constitutes a superspecies that is confined largely to the Indian subregion of the Oriental region. In general, the *niveus* subgroup seems to be the closest related section of the subgenus. Nearly all the species of this subgroup are treated in detail by Barraud (1934).

## Subgroup IV, TSILIENSIS

*Definition.*—Australasian. Male palpi as in Subgroup I. Basistyle with a prominent inner median tuft of scales. Claspette filament bladeliike, expanded. Scutum with a pale scaled area across the front half, at least some separate pale scales before wing base (female unknown). *Ppn* with the upper half covered with narrow pale scales. Postspiracular scales absent. Fore tibiae with a dorsal white area at the apex. Hind tarsi with a basal white spot and an apical ring on I, a narrower basal ring on II.

*Supplementary characters.*—Vertex dorsum narrow scaled. Preala scaled below knob. Subspiracular area unscaled. Sternites without outstanding or roughened scales apically.

*Included species.*—*A. tsiliensis* King and Hoogstraal.

## Subgroup V, UNICINCTUS

*Definition.*—Oriental. Male palpi and basistyle as in Subgroup I. Claspette filament bladeliike, expanded. Scutum as in Subgroup III; however the anterior pale area is greatly reduced and fragmented in female; in male the three pale areas are coalesced. *Ppn* with a patch of broad scales. Postspiracular scales absent. Fore tibiae with a dorsal white area at apex. Hind tarsi dark except for a basal white ring on I.

*Supplementary characters.*—Preala scaled below knob. Subspiracular scale patch present. Some of the sternites with outstanding or roughened scales apically.

*Included species.*—*A. unicinctus* Edwards.

## Subgroup VI, SEOULENSIS

*Definition.*—Palearctic. Male palpi and basistyle as in Subgroup I. Claspette filament somewhat bladeliike in lateral view. Scutum with anterior half pale scaled, this connected with pale scaled area before wing bases and not of a different color from latter area. *Ppn* with narrow curved white scales. Fore tibiae with the apex not pale scaled anteriorly. Hind tarsi with broad basal bands on I-III, narrow apical bands on I-II, a few pale scales basally on IV.

*Supplementary characters.*—Vertex dorsum broad scaled (narrow ones along ocular margin and on nape). Preala scaled below knob. Subspiracular scale patch present. Sternites without outstanding or roughened scales apically.

*Included species.*—*A. seoulensis* Yamada.



## Subgroup VII, ATROPALPUS

*Definition.*—Nearctic and Neotropical. Male palpi with a few short hairs apically on III–V and only a few hairs along IV–V; palpi only about two-thirds to three-fourths as long as proboscis. Basistyle without a specialized scale tuft. Claspette filament curved, bladelike in lateral view. Scutum with a large anterior area of yellow scales (usually divided medially by a dark scaled area), anterior area of pale scales not separate from, nor of a different color than, patch of pale scales before wing base. *Ppn* with broad or narrow scales above, broadened below. Postspiracular area scaled. Fore tibiae with a dorsal white area at apex. Hind tarsi with narrow basal and apical bands on I–IV, V usually all white.

*Supplementary characters.*—Vertex dorsum with longitudinal medial area narrow scaled. Preala scaled below knob. Subspiracular scale patch present. Sternites without outstanding or roughened scales.

*Included species.*—*A. atropalpus* (Coquillett) and *a. var. epactius* Dyar and Knab.

## Group C (LONGIPALPIS-group)

Ethiopian species (plus three species in Madagascar). Wings not spotted with areas of pale scaling. Scutum variously marked with patches and/or straight lines of narrow curved or broad scales. Femora and tibiae not spotted and ringed, nor lined anteriorly with pale scales for nearly their whole length. Hind tarsi with a broad white ring at base of II, usually also a narrower ring at base of I, may be a few white scales at base of III, remainder of the segments dark (but female *embuensis* has a definite basal band one-third length of segment III; *nyasae* has V all white, or darkened only on one side; *monetus* and *phillipi* have the tarsi all dark). Paratergite scaled.

The males of *barnardi*, *madagascarensis*, and *monetus*; the female of *phillipi*; and the larvae of *barnardi*, *embuensis*, *madagascarensis*, *monetus*, *nyasae*, and *phillipi* are not described.

In addition, this group is characterized by the following: Male palpi with or without long hairs at apex of III and along IV and V. Basistyle without a specialized scale tuft. Claspette filament slender, curved, not bladelike in lateral view. *Ppn* and scutellum with narrow curved and/or broad scales. Subspiracular area scaled or unscaled. Postspiracular area unscaled (except in *madagascarensis*). Female tori without prominent scale patch, may be a few small scales in some (except in *madagascarensis*). Larval head hairs 6 and 7 approximately in line transversely, 5 and 6 approximately in a longitudinal line, 4 level with or slightly behind 6.

There are two types of thoracic scaling in this group, in one the ornamentation is of broad metallic silvery scales (*fulgens*, *longipalpis*, and *monetus*), in the other the ornamentation is of narrow curved pale scales (all the remaining species possess this latter type except *phillipi*, which shows a combination of the two). The six larvae known are of two types, those with head hair 4 small and lateral comb a triangular patch of fringed scales (*fulgens*, *longipalpis*, and *pulchrithorax*) and those with head hair 4 well developed and lateral comb a row of pointed spines (*embuensis*, *ingrami*, and *wellmanii*). It is felt that any attempt at subdividing this group must await further knowledge of the early stages of the remaining five species. *A. monetus* has a patch of flat silvery scales at the base of the metapostnotum (i. e., on it) and some specimens of *fulgens* also have scales in that position.

The adults and pupae of many of the species of Group C have been treated by Edwards (1941), and the larvae by Hopkins (1936).

*Included species*.—*A. barnardi* Edwards, *embuensis* Edwards, *fulgens* (Edwards), *ingrami* Edwards, *longipalpis* (Grünberg), *madagascarensis* van Someren, *monetus* Edwards, *nyasae* Edwards, *phillipi* van Someren, *pulchrithorax* Edwards, and *wellmanii* (Theobald).

**Group D (AUREOSTRIATUS-group: HULECOETEOMYIA)**

Australasian, Oriental, Palaearctic, and Neotropical species. Wings not spotted with areas of pale scaling. Scutal marking pattern consisting largely of a pattern of longitudinal lines of white to yellow scales, may also be one or three small spots on the anterior margin, a patch on posterior margin of fossa (scutal angle), and a small patch just before the wing base (all of these patches are distinctly insignificant). Sometimes the longitudinal lines are quite diffused in outline (Subgroups II, IV, and VI), and in a few species some individuals have the lines either missing altogether or else obscured by general pale scaling. Such individuals will key into Group F. Femora and tibiae not spotted and ringed nor lined anteriorly with pale scales for nearly their whole length (some individuals of *quasirubithorax* have a fairly definite anterior line on mid-tibiae and a less definite line on mid-femora and would possibly key into Group E). Hind tarsal markings various, but in all, except some specimens of *sintoni*, at least the first three segments are banded basally.

The exact position of *wasselli* Marks within the group is in doubt, owing to the male and larva being as yet unknown.

## KEY TO THE SUBGROUPS OF GROUP D (AUREOSTRIATUS-GROUP)

1. Postspiracular area scaled..... 2  
Postspiracular area not scaled..... 5
2. Hind tarsi without apical pale markings.  
SUBGROUP I, *chrysolineatus* (p. 527)  
Hind tarsi with apical pale markings on some segments..... 3
3. Hind tarsi with narrow pale rings at base and apex of I and at base of II, in some specimens a few pale scales over joints of some of succeeding segments also; (male palpi with numerous long hairs apically on III and along IV)..... SUBGROUP III, *sintoni* (p. 528)  
Hind tarsi with basal and apical bands on I-IV, V either with basal band or else all white..... 4
4. Hind tarsal V all white; male palpi with numerous long hairs apically on III and along IV..... SUBGROUP VII, *scutellalbum* (p. 530)  
Hind tarsal V basally banded; male palpi with a few apical hairs on III-V, none or very few hairs along these segments... SUBGROUP VI, *togoi* (p. 529)
5. Paratergite scaled..... 6  
Paratergite not scaled..... 7
6. Hind tarsal segment V entirely white... SUBGROUP IV, *quasirubithorax* (p. 529)  
Hind tarsal segment V not entirely white (basally banded or with pale reflections dorsally)..... SUBGROUP VIII, *gracilelineatus* (p. 530)
7. Subspiracular area scaled; male palpi straight, III-V with a few apical hairs, none or very few hairs along IV-V... SUBGROUP II, *aureostriatus* (p. 528)  
Subspiracular area not scaled; male palpi with numerous long hairs apically on III and along IV..... SUBGROUP V, *candidoscutellum* (p. 529)

## Subgroup I, CHRYSOLENEATUS

*Definition.*—Oriental, with representatives in the Palaearctic region. Male palpi straight; III-V with a few apical hairs, none or very few hairs along IV-V, occasionally may be up to about seven lateral hairs on either side of IV and about four hairs along V (males of *pallirostris* and *rizali* are unknown). Basistyle without a tuft of specialized scales. Hind tarsi with basal bands on the first 3-4 segments, occasionally a few basal pale scales on V in *koreicus*, no apical pale scaling present. Postspiracular area scaled. Paratergite and subspiracular area scaled or unscaled.

*Supplementary characters.*—This subgroup is a superspecies in nature, and is further characterized by the combination of the following characters: Male palpi shorter than proboscis (about three-fourths to four-fifths as long). Claspette filament curved, bladelike. Female tori scaled mesally. Halter knob dark scaled on one side, pale scaled on the other. Scutum with distinct narrow longitudinal whitish-yellow or yellow lines as follows: A distinct median line, a submedian line that tends to be broken at scutal angle (the anterior end of posterior portion of this line frequently curved outward along the scutal angle), and a line over the wing base (this may be just a diffused area in some species). Also, a small patch of long narrow curved scales occurs just before the wing base. Preala scaled below knob. Larval



head hairs 4, 5, and 6 very nearly in a straight horizontal line, 7 posterior to this line. Comb scales numerous, in a patch. Larval habitat: Rock holes in stream beds, tree holes, and bamboos; less commonly *Colocasia* leaf axils, water collected on fallen forest leaves, and in artificial containers. The larvae of *pallirostris* and *rizali* are not described.

*Included species*.—*A. abadsantosi* Baisas, *burgosi* Baisas, *chryso-lineatus* (Theobald), *formosensis* Yamada, *harveyi* (Barraud), *japonicus* (Theobald), *jugraensis* (Leicester), *koreicus* (Edwards), *harveyi* var. *nigrorhynchus* Brug, *pallirostris* Edwards, *rizali* (Banks), *saxicola* Edwards, and *sherki* Knight.

*Discussion*.—The species included here have been treated by Knight (1948).

#### Subgroup II, AUREOSTRIATUS

*Definition*.—Australasian, Oriental, and Palaearctic species. Male palpi and basistyle as in Subgroup I (the male of *aureostriatus* is undescribed). Hind tarsi with all the segments basally banded (III–V appearing all dark in some males of *okinawanus*, however), some of the segments also always apically banded, V may be largely white. Postspiracular area unscaled. Paratergite unscaled. Subspiracular area scaled.

*Supplementary characters*.—Claspettes with a peculiar basotergal lobe bearing specialized scales. Claspette filament a twisted, rounded leaf. Female tori not scaled (may be dark hairs medially). In general, scutal markings as in Subgroup I, though usually not so distinct and sharp; in *aureostriatus* var. *greenii* the lines are obscured by general pale scaling. Preala scaled below the knob. Larval head hairs 4, 6, and 7 inserted very nearly in a horizontal line. Comb scales numerous, in a patch. Larval habitat: tree holes and bamboos. The larvae of *aureostriatus* and *a.* var. *kanaranus* are undescribed.

*Included species*.—*A. aureostriatus* (Doleschall), *a.* var. *greenii* (Theobald), *a.* var. *kanaranus* (Barraud), and *okinawanus* Bohart.

#### Subgroup III, SINTONI

*Definition*.—Oriental. Male palpi with numerous long hairs arising apically on III and all along IV, some also present on V. Basistyle with a prominent inner tuft of specialized scales. Hind tarsi with narrow pale rings at base and apex of I and base of II, a few pale scales over joints of succeeding segments in some specimens. Postspiracular, subspiracular, and paratergite areas scaled.

*Supplementary characters*.—Claspette filament bladelike. Female tori with pale scales. Scutum with three small patches of pale scales on anterior margin, the lateral patches continued as a pale scaled line on each side to wing base; a line of similar scales from front on



each side curving over wing base to lateral lobe of scutellum; prescutellar area bordered with pale scales. Preala scaled below knob. Larva not described. Larval habitat: rock pools in stream beds.

*Included species*.—*A. sintoni* (Barraud).

#### Subgroup IV, QUASIRUBITHORAX

*Definition*.—Australasian. Male palpi as in Subgroup III. Basistyle with a row of modified scalelike bristles (showing at least 1-4 striations) arising from the inner surface. Hind tarsi with basal pale bands on I-IV, V all white, I and II (sometimes also III) with apical pale scaling (very few apical pale scales present on type series of *keefei*). No postspiracular scales. Paratergite scaled. Subspiracular scales present or absent.

*Supplementary characters*.—Claspette filament bladeliike. Female tori with fine hairs medially. Scutal linear pattern frequently rather diffused or clouded. Preala scaled below knob. Larval head hair 5 posterior to 6, 7 on a horizontal line between 5 and 6, 4 located between the bases of 5. Comb consisting of a curving row of scales. Larval habitat: tree holes.

*Included species*.—*A. quasirubithorax* (Theobald) and *keefei* King and Hoogstraal.

#### Subgroup V, CANDIDOSCUTELLUM

*Definition*.—Australasian. Male palpi as in Subgroup III. Basistyle without a specialized scale tuft. Hind tarsi with basal pale bands on I-IV, V all white, II-III with small apical pale patches, IV may rarely be all dark. Postspiracular, subspiracular, and paratergite areas unscaled.

*Supplementary characters*.—Claspette filament bladeliike. Female tori with fine hairs medially. Scutal linear pattern very diffused. No prealar scale patch. Larval head hair 6 arising on a level with 7, 5 posterior to 6, 4 inserted between the bases of 5. Comb consisting of a patch of many scales. Larval habitat: tree holes.

*Included species*.—*A. candidoscutellum* Marks.

#### Subgroup VI, TOGOI

*Definition*.—Palearctic. Male palpi and basistyle as in Subgroup I. Hind tarsi with basal bands on I-V, apical bands on I-IV. Postspiracular and subspiracular areas scaled. Paratergite scaled.

*Supplementary characters*.—Claspette filament whiplike. Female tori scaled medially. Scutal linear pattern sometimes partially obscured, never sharp and distinct. Preala scaled below knob. *Ppn* with broad scales. Larval head hairs 4, 5, and 6 in a horizontal line near the front of the head and anterior to the level of 7. Comb consisting of a patch of many scales. Anal gills globular. Larval

habitat: fresh to highly saline water collected in rock pools and artificial containers near the seacoast.

*Included species.*—*A. togoi* (Theobald).

Subgroup VII, SCUTELLALBUM

*Definition.*—Neotropical. Male palpi as in Subgroup III. Basistyle without specialized scale tuft. Hind tarsi with basal and apical white bands on I–IV, V all white. Postspiracular area and paratergite scaled. Subspiracular area not scaled in male (could not see this character on female).

*Supplementary notes.*—Claspette filament narrowly bladelike in lateral view. Female tori scaled medially. Scutum with a pattern of thin distinct lines. Preala scaled below knob. *Ppn* with narrow scales. Larval head hair 5 behind and slightly internal to 6, 7 on a level just anterior to 6, 4 internal to the base of 6. Comb scales in a patch. Larval habitat: rock pools in stream beds.

*Included species.*—*A. scutellalbum* Boshell-Manrique.

Subgroup VIII, GRACILELINEATUS

*Definition.*—Australasian. Male palpi as in Subgroup III. Basistyle without a specialized scale tuft. Hind tarsi with basal bands on I–V, no apical bands (V may have pale reflections dorsally in some lights). Postspiracular area bare. Subspiracular area and paratergite scaled.

*Supplementary characters.*—Claspette filament bladelike. Female tori unscaled. Scutal linear pattern with broken lateral lines, the median line more or less complete, but the lines tending to be indistinctly separated anteriorly in male. Preala scaled below knob. *Ppn* with narrow-curved scales only. Larva unknown.

*Included species.*—*A. gracilelineatus* Bonne-Wepster.

Group E (MEDIOVITTATUS-group: GYMNOMETOPA)

Australasian, Oriental, and Neotropical species. Wings not spotted with areas of pale scaling. Scutal marking pattern consisting of a pattern of narrow distinct longitudinal lines of white to yellow scales. Femora (at least the mid-), and usually also one or more of the tibiae, with an anterior narrow longitudinal line of pale scales for nearly their whole length; not spotted or ringed with pale scaling. Hind tarsi with basal bands on I to IV or V (V may be all white), apical pale scaling also present on some segments (except in *mallochi*, *mediovittatus*, and *?hegneri*).

In addition the female tori possess a medial scale patch (only hairs or else just a few scales in *quinquelineatus*), and the paratergite is scaled. Larval habitat: Tree holes, bamboos, rock pools, and artificial containers.

KEY TO THE SUBGROUPS OF GROUP E (MEDIOVITTATUS-GROUP)

1. Tibiae without an anterior narrow longitudinal line of pale scales, rather each with an anterior white spot shortly before middle.

SUBGROUP I, *mediovittatus* (p. 531)

Usually some of the tibiae with an anterior narrow longitudinal line (may be broken and even partially obsolete) of pale scales for most of their length. 2

2. Scutellar scales all broad-----SUBGROUP II, *notoscriptus* (p. 531)  
At least a portion of scales on scutellum narrow; (postspiracular area  
scaled)-----SUBGROUP III, *pseudotaeniatus* (p. 532)

**Subgroup I, MEDIOVITTATUS, s. str.**

*Definition*.—Neotropical. Scutellum with all broadened scales. Postspiracular area not scaled. Tibiae without an anterior narrow longitudinal line of pale scales, rather each with an anterior white spot shortly before the middle.

*Supplementary characters.*—Male palpi straight, with a few short apical hairs on III–V, none or very few hairs along IV–V. No prealar scale patch. *Ppn* with all broad scales. Head hair 6 of larva far forward, 4 slightly behind and internal to 6, 5 approximately in line with 7. Comb teeth few, in a line. Larval habitat: Tree holes and artificial containers.

*Included species.*—*A. mediovittatus* (Coquillett).

### Subgroup II. NOTOSCRIPUS

*Definition.*—Australasian (one Oriental species). Scutellum with all broad scales (female of *n. var. montanus* undescribed). Postspiracular area not scaled, except in *mallochi*. Tibiae with an anterior narrow longitudinal line of pale scales (on at least one pair of them).

*Supplementary characters.*—Male palpi with long hairs arising apically on III and all along IV and V. In *albilabris*, however, there are some short apical hairs on III–V, and only a few hairs along IV (males of *mallochi* and *quinquelineatus* undescribed). Preala scaled below knob. *Ppn* with all broad scales. Head hair 6 of larva far anterior to 5, 7 on a level near to 5, 4 near base of 6 (this arrangement is much the same as that found in Subgroup I). Comb scales numerous, in a patch. Larval habitat: Tree holes, rock pools, and artificial containers. The larvae of *mallochi*, n. var. *montanus*, and *quinquelineatus* are undescribed.

*Included species*.—*A. albilabris* Edwards, *mallochi* Taylor, *notoscriptus* (Skuse), n. var. *montanus* Brug, and *quinquelineatus* Edwards.

*Discussion.*—Judged by the different palpal types included, this is probably not a natural grouping.







3. Midtarsal segment I with basal pale band at least one-third length of segment (at least on outer surface).  
Australasian.....SUBGROUP IV, *purpureus* (p. 535)  
Neotropical.....*knabi* of SUBGROUP X, *knabi* (p. 538)  
Midtarsal segment I with basal pale band not more than one-fourth length of segment ..... 4
4. Hind tarsi with I and II basally banded, may be a few basal pale scales on III in some specimens; (paratergite bare, postspiracular area scaled).  
SUBGROUP XI, *fengi* (p. 538)  
Hind tarsi with basal bands on at least first three segments, frequently on more..... 5
5. Anterior one-half to two-thirds of scutum largely pale scaled or with median longitudinal stripe or patch of pale scales; (femora not mottled)..... 6  
Without the above combination of characters (scutum various but if as above, femora are mottled)..... SUBGROUP VI, *alboannulatus* (p. 536)
6. Scutum marked with either a large area or a median longitudinal stripe of pale scales (either silvery white or golden) on anterior two-thirds, this pale area sharply delimited laterally and posteriorly from surrounding dark scaled areas.....SUBGROUP II, *papuensis* (p. 534)  
Scutum with the anterior half largely pale scaled (or at least not with a pale area that is sharply set off from dark scaled background), the margins of pale scaled area seldom sharply defined..... 7
7. Postspiracular area scaled; paratergite bare.  
SUBGROUP VII, *auronitens* (p. 537)  
Postspiracular area bare; paratergite scaled..... 8
8. Female tori prominently scaled medially; (basistyle without a tuft of modified scales; female eighth abdominal segment not higher than broad, sternite prominently scaled; Neotropical).....SUBGROUP IX, *fluviatilis* (p. 538)  
Female tori not scaled..... 9
9. Basistyle with a tuft of modified scales; Australasian.  
SUBGROUP VIII, *biocellatus* (p. 537)  
Basistyle without a tuft of modified scales; sub-Neartic; (female eighth abdominal segment higher than broad, sternite markedly compressed laterally and bare of scales, or nearly so).....SUBGROUP X, *knabi* (p. 538)

#### Subgroup I, *ALBOTAENIATUS*

*Definition*.—Oriental. Basistyle with a tuft of modified scales on the inner sternal surface (the male of *a. var. mikiranus* is unknown). Claspette filament bladeliike. Male palpi with long hairs arising apically on III, and all along IV and V. Female tori scaled, or with hairs only (female of *lepchana* undescribed). Scales of vertex dorsum broad; may be narrow scales on the ocular margin and nape, however. Scutal scaling not as in Subgroup II. Hind tarsi with first three or four segments with basal pale bands, sometimes a few basal pale scales on V; may be a few apical pale scales on one or more segments. Paratergite unscaled. Postspiracular area with or without scales. *Ppn* with narrow scales, or else all broad scales. Neither femora nor tibiae sprinkled with pale scales anteriorly.

*Supplementary characters.*—Subspiracular area with or without scales. Preala scaled below knob. Scutellum with narrow scales. Larval head hair 6 anterior to 5, 4 anterior and mesad of 6, 7 on a level intermediate between those of 5 and 6 (only the larva of *harperi* is described). Comb teeth few, in a row. Larval habitat: bamboos.

*Included species.*—*A. albotaeniatus* (Leicester), *a. var. mikiranus* Edwards, *harperi* Knight, *lepchana* (Barraud) (possibly a synonym of *albotaeniatus*), and *stevensoni* (Barraud).

*Discussion.*—This subgroup is probably not a completely homogeneous unit, since *albotaeniatus*, *a. var. mikiranus*, and *lepchana* all possess a postspiracular scale patch; and *harperi* and *stevensoni* lack it. Until all the larvae are known, it will probably not be possible definitely to decide this point. For a recent discussion of this subgroup see Knight (1948b).

#### Subgroup II, PAPUENSIS

*Definition.*—Australasian. Basistyle without a tuft of specialized scales (males of *alticola* and *derooki* are unknown). Claspette filament bladelike in lateral view. Male palpi as in Subgroup I. Female tori not scaled, except in *anggiensis* (female of *clintoni* unknown). Vertex dorsum with at least median longitudinal band narrow scaled. Scutum marked with either a large area or a median longitudinal stripe of pale scales (either silvery white or golden) on anterior two-thirds, this pale area sharply delimited laterally and posteriorly from surrounding dark scaled areas. *Ppn* with narrow scales above (may be none in *dobodurus*), broad below (only narrow scales present in *anggiensis*, *toxopeusi*, and *alticola*). Postspiracular area with or without scales. Paratergite scaled (except *derooki*). Hind tarsi with broad basal pale bands on at least first four segments, sometimes on all five, no apical pale scaling. Neither femora nor tibiae sprinkled with pale scales anteriorly.

*Supplementary characters.*—Scutellum narrow scaled. Subspiracular and prealar areas with or without scales. Larval head hairs 4, 5, and 6 in a small anterior group, hair 7 behind or level with the posterior margin of this group. Larval habitat: Tree holes, rot holes, rock pools, fallen leaves, artificial containers, and a variety of other small water-holding containers in forested areas. The larvae of *alticola*, *anggiensis*, *clintoni*, *derooki*, and *toxopeusi* are undescribed.

*Included species.*—*A. alticola* Bonne-Wepster, *anggiensis* Bonne-Wepster, *argenteitarsis* Brug, *clintoni* Taylor, *derooki* Brug, *dobodurus* King and Hoogstraal, *hollandius* King and Hoogstraal, *novalbitarsis* King and Hoogstraal, *palmarum* Edwards, *papuensis* (Taylor), *subalbitarsis* King and Hoogstraal, and *toxopeusi* Bonne-Wepster.

*Discussion.*—This subgroup is particularly distinct from all the other subgroups of Group F in the nature of the scutal scaling and in the arrangement of the larval head hairs. Some specimens of *alticola* may go to Subgroup VI and possibly the species is even intermediate between Subgroups II and VI. The position of this species will remain uncertain until the male and larva are described. King and Hoogstraal (1946) treat this subgroup in detail.

#### Subgroup III, SIMLENSIS

*Definition.*—Oriental. Basistyle without a tuft of specialized scales (male of *simlensis* is undescribed). Claspette filament bladelike. Male palpi as in Subgroup I. Female tori scaled medially. Vertex dorsum broad scaled (may be narrow scales along ocular margin and on nape). Scutal scaling not as in Subgroup II. *Ppn* with at least some narrow scales. Postspiracular area not scaled. Paratergite without scales, a few present in *simlensis*, however. Neither femora nor tibiae sprinkled with pale scales anteriorly. Hind tarsi with first three to four segments with basal white bands, sometimes a very few apical white scales on one or more segments.

*Supplementary characters.*—Scutellum with narrow scales. Subspiracular area with or without scales. Preala scaled below knob. Type of larval head hairs widely different in *albocinctus* and *gilli*, being well developed and branched in first, and with 5 and 6 very long and single in latter (the larva of *simlensis* is undescribed). Comb teeth numerous, in a patch. Larval habitat: tree holes.

*Included species.*—*A. albocinctus* (Barraud), *gilli* (Barraud), and *simlensis* Edwards.

*Discussion.*—On the basis of the larval difference mentioned above, it is believed that this is not a natural subgroup. The adults of this subgroup can be separated from those of Subgroup I only on the absence of a tuft of modified scales on the basistyle. For a comprehensive discussion of the species included here, see Barraud (1934).

#### Subgroup IV, PURPUREUS (Molpemyia)

*Definition.*—Australasian. Basistyle without a tuft of specialized scales. Claspette filament bladelike in lateral view. Male palpi as in Subgroup I. Female tori with dark hairs medially (in some specimens of *auridorsum* there are a few small flat dark scales here). Vertex dorsum with narrow scales. Scutal scaling not as in Subgroup II. Postspiracular area bare. Paratergite scaled. Neither femora nor tibiae sprinkled with pale scales anteriorly. Hind tarsi with basal bands on I–III, rarely on IV; V sometimes pale in *auridorsum*.

*Supplementary characters.*—Scutellum with narrow scales. Subspiracular area with or without scales. Preala scaled below knob.



Approximately basal one-half of hind femur creamy scaled anteriorly. White band on midtarsal segment I at least one-third length of segment. Dark scales on abdomen, legs, et cetera, with purplish reflections. Head hair 6 of larva anterior to 5, 4 between bases of 6, 7 on a level between those of 5 and 6. Comb scales few, in a line. Ventral brush borne on a modified sclerotized plate separate from the anal plate. Larval habitat: tree holes.

*Included species.*—*A. auridorsum* Edwards and *purpureus* (Theobald).

*Discussion.*—The relationship of the two species included here would be somewhat in doubt were it not for the marked similarity between the larvae.

#### Subgroup V, SUBSIMILIS

*Definition.*—Oriental. Basistyle without a tuft of modified scales. Claspette filament needlelike. Male palpi with some hairs at the apices of III–V, none or very few along IV and V. Vertex dorsum broad scaled (female unknown). Scutum all dark scaled. *Ppn* bare. Neither femora nor tibiae sprinkled with pale scales anteriorly. Hind tarsi with the first four hind tarsal segments basally banded.

*Supplementary characters.*—Scutellar scales broad. Larva undescribed.

*Included species.*—*A. subsimilis* (Barraud).

*Discussion.*—The only specimen that has been seen by us is the type, and the pin has so obliterated the pleuron on this specimen that it is impossible to determine which scale patches are present.

#### Subgroup VI, ALBOANNULATUS, s. str.

*Definition.*—Australasian. Basistyle without a tuft of specialized scales (male of *occidentalis* not specifically described). Claspette filament slender bladelike in lateral view. Male palpi as in Subgroup I. Female tori with or without scales. Vertex dorsum narrow scaled. Scutal scaling various, often with indefinite lines or patches, not as in Subgroup II. *Ppn* with narrow-curved and/or flat scales. Postspiracular area with or without scales. Paratergite scaled. In some species femora, and sometimes the tibiae also, with anterior surface sprinkled with pale scales. Hind tarsi with segments I–IV or V basally banded (the bands not extending onto the apices of preceding segments).

*Supplementary characters.*—Scutellum with narrow curved scales. Subspiracular area scaled. Larval head hairs 6 and 7 approximately in a horizontal line, 5 slightly caudad and mesad to 6, 4 mesad to 5. Comb scales numerous and in a patch. Larval habitat: Fresh-



water ground and rock pools, occasionally in brackish marshes, fallen palm fronds, holes in fallen logs, and other similar containers. Larva of *mackerrasi* undescribed.

*Included species*.—*A. alboannulatus* (Macquart), *mackerrasi* Taylor, *occidentalis* (Skuse), and *o. var. milsoni* (Taylor).

#### Subgroup VII, AURONITENS

*Definition*.—Oriental. Basistyle without a tuft of specialized scales. Claspette filament bladelike in lateral view. Male palpi with some hairs at the apices of III–V, none or very few along IV and V. Female tori with pale scales medially. Vertex dorsum narrow scaled. Scutal scaling not as in Subgroup II. *Ppn* with both narrow and broad scales. Postspiracular area scaled. Paratergite without scales. Neither femora nor tibiae sprinkled with pale scales anteriorly. Hind tarsi with the first 3–4 segments basally banded, sometimes a few pale scales apically.

*Supplementary characters*.—Scutellar scales narrow. Subspiracular and prealar areas scaled. Larval head hairs, 4, 6, 7 approximately on a transverse line, 5 slightly behind and mesad of 6. Comb scales numerous, in a patch. Larval habitat: tree holes.

*Included species*.—*A. auronitens* Edwards and *christophersi* Edwards.

*Discussion*.—For a comprehensive treatment of these species see Barraud (1934). On the basis of the similarity of male genitalia and larva, this would appear to be a rather natural grouping. The larvae of *a. var. greenii* and *gilli* show considerable relationship to those of this subgroup.

#### Subgroup VIII, BIOCELLATUS

*Definition*.—Australasian. Basistyle with specialized scale tuft (male of *australiensis* unknown). Claspette filament bladelike in lateral view. Male palpi as in Subgroup I. Female tori with only fine hairs medially. Vertex dorsum narrow scaled. Scutal scaling not as in Subgroup II. *Ppn* with at least some narrow scales. Postspiracular area bare. Paratergite scaled. Neither femora nor tibiae speckled anteriorly with pale scales. Hind tarsi with first three or four segments basally banded.

*Supplementary characters*.—Scutellum with at least some narrow scales. Subspiracular area with or without scales. Preala scaled below knob. Larval head hairs 4, 6, and 7 approximately in a transverse line; 5 inserted a short distance posterior to 6, 4 unusually large. Comb scales in an irregular line, or numerous in a patch. Larval habitat: tree holes.

*Included species.*—*A. australiensis* (Theobald), *biocellatus* (Taylor), and *monocellatus* Marks.

*Discussion.*—Scales on the scutum of the three species included here are fairly uniform in size, though the density of the scaling may vary; *australiensis* has the posterior margin of the pale scaled area on the scutum sharply defined, but differs from Subgroup II in having no dark scaling on the anterior half of scutum.

#### Subgroup IX, FLUVIATILIS

*Definition.*—Neotropical. Basistyle without a tuft of specialized scales. Claspette filament bladelike in lateral view. Male palpi as in Subgroup I. Female tori scaled medially. Vertex dorsum with narrow scaling at least medially. Scutal scaling not as in Subgroup II. *Ppn* largely narrow scaled. Postspiracular area without scales. Paratergite scaled. Neither femora nor tibiae speckled anteriorly with pale scales. Hind tarsi with I–IV basally banded, may be a few basal pale scales on V; one or more segments may have some apical pale scaling.

*Supplementary characters.*—Scutellum with narrow scales. Subspiracular area scaled. Preala scaled below knob. Larval head hair 5 posterior and slightly mesad to 6 and approximately on a transverse line with 7, 4 mesad of 5. Comb scales numerous, in a patch. Larval habitat: rock pools in stream courses.

*Included species.*—*A. fluvialis* (Lutz).

#### Subgroup X, KNABI

*Definition.*—Neotropical and sub-Nearctic. Claspette filament nearly cylindrical, curved and appearing bladelike in lateral view however (the male of *knabi* is undescribed). White band on mid-tarsal segment I usually only about one-fourth length of segment in *zoosophus*. Basal bands on hind tarsal segments I–IV, may be a few basal pale scales on V. Midlobe of scutellum broad scaled, lateral lobes narrow scaled. Ventral brush of larva not on a plate. Subspiracular area scaled. Remainder as in Subgroup IV.

*Included species.*—*A. knabi* (Coquillett) and *zoösofus* Dyar and Knab.

#### Subgroup XI, FENGII

*Definition.*—Palearctic. Basistyle without a specialized tuft of scales. Claspette filament bladelike in lateral view. Male palpi with long hairs arising apically on III, and all along IV. Female tori scaled. Vertex dorsum narrow scaled. Scutal scaling not as in Subgroup II. *Ppn* scaling broad and spindle shaped. Postspiracular area scaled. Paratergite bare. Neither femora nor tibiae sprinkled with pale scales anteriorly. Hind tarsi with I and II basally banded, may be a few basal pale scales on III in some specimens.

*Supplementary characters.*—Scutellar scales narrow. Subspiracular area scaled. Preala scaled below knob. Larval head-hair arrangement not described. Comb scales in a line. Larval habitat: bamboo stumps.

*Included species.*—*A. fengi* Edwards.

*Discussion.*—This species shows some relationship to *unicinctus* in Group B.

Group H (GENICULATUS-group: PROTOMACLEAYA)

Australasian, Oriental, Palaearctic, Neotropical, and Nearctic species. Wings not spotted with areas of pale scaling. Scutal markings various, but not consisting largely of a pattern of longitudinal pale lines (except in *eatoni* where it is entirely of lines except for a small patch before wing base), nor as in Group B. Femora and tibiae not spotted and ringed, nor lined anteriorly with pale scales for nearly their whole length. Tarsi completely dark.

In the absence of specimens or additional descriptive information, it has not been possible to assign either *peipingensis* Feng or *yunnanensis* (Gaschen) to subgroups.

This group includes all of the dark-legged *Finlaya* species known except the two Madagascar species *monetus* and *phillipi* (which on general relationships are placed in Group C in this paper).

KEY TO THE SUBGROUPS OF GROUP H (GENICULATUS-GROUP)

1. Paratergite not scaled.....SUBGROUP I, *niveus* (p. 539)  
Paratergite scaled..... 2
2. *Ppn* with broad flat overlapping silvery scales; no postspiracular, subspiracular, or prealar scales.....SUBGROUP II, *dissimilis* (p. 540)  
Not with the above combination of characters..... 3
3. Scales of vertex dorsum broad (may be narrow scales along eye margin and on nape); (male palpi without numerous long hairs along IV and V)  
SUBGROUP VII, *leucocelaenus* (p. 542)  
Scales of vertex dorsum narrow, at least along longitudinal midline..... 4
4. Basistyle with a tuft of specialized scales on the inner surface; (female tori and postspiracular area scaled).....SUBGROUP III, *pulchriverter* (p. 541)  
Basistyle without a tuft of specialized scales..... 5
5. Female tori scaled; (postspiracular area scaled, upper *ppn* scales narrow).  
SUBGROUP V, *suffusus* (p. 541)  
Female tori not scaled.  
Oriental.....SUBGROUP IV, *oreophilus* (p. 541)  
Nearctic and Palaearctic.....SUBGROUP VI, *geniculatus* (p. 541)

Subgroup I, NIVEUS

*Definition.*—All Oriental species, except one Australasian and one Palaearctic species. Basistyle with a specialized scale tuft (males of *idjenensis* and *pseudoniveus* undescribed). Claspette filament blade-like. Male palpi with sparse long hairs apically on III, and along IV and V. Female tori bare of scales (female of *niveoides* un-

described). Vertex dorsum broad scaled (may be narrow scales along eye margin and on nape, however). *Ppn* bare, or nearly so. Paratergite and postspiracular area without scales.

*Supplementary characters.*—Black and white species. Scutum with at least anterior one-half covered with white scales; this may be partially or completely divided medially by dark scales (in *idjenensis* the pale scutal scales are pale golden). Scutellar scales broad. Subspiracular area without scales. Preala scaled below knob (scales absent in *dorseyi*). No femora knee spots. Larval head hair 6 anterior to 5, 4 between bases of 6, 5 and 7 approximately in line. Comb teeth few, in a line. Larval habitat: Tree holes, bamboos, and artificial containers. The larvae of *idjenensis* and *pseudoniveus* are undescribed.

*Included species.*—*A. albolateralis* (Theobald), *alboniveus* Barraud, *dorseyi* Knight, *idjenensis* Brug, *lacteus* Knight, *laoagensis* Knight, *niveoides* Barraud, *niveus* (Ludlow), *n. nipponicus* LaCasse and Yamaguti, *novoniveus* Barraud, *pseudoniveus* Theobald, and *saperoi* Knight.

*Discussion.*—This subgroup, which is probably a superspecies, has been treated by Knight (1946).

#### Subgroup II, DISSIMILIS

*Definition.*—Oriental. Basistyle without a specialized scale tuft (males of *d. var. karwari* and *leucomeres* unknown). Claspette filament needlelike. Male palpi with a few hairs on apices of III–V, none or very few along IV–V (the palpi of *dissimilis* is as in the *niveus* group, however). Female tori bare (female of *leucopleurus* undescribed). Vertex dorsum broad scaled (may be narrow scales along eye margin and on nape, however). *Ppn* with broad, flat, silvery scales. Postspiracular area without scales. Paratergite scaled.

*Supplementary characters.*—Scutum clothed with black scales, sometimes an anterior variable central area of golden scales present. Scutellar scales broad. Subspiracular and prealar areas without scales. Some femora with anterior white just before apex; mid-femora with an anterior median silvery mark. Larval head hairs 4, 6, and 7 approximately in line, 5 posterior to and near to 6. Comb scales in a patch. Larval habitat: Tree holes, bamboos, and artificial containers. Larvae of *d. var. karwari* and *leucomeres* unknown.

*Included species.*—*A. dissimilis* (Leicester), *d. var. karwari* (Barraud), *leucomeres* (Giles), *leucopleurus* Rozeboom, *luzonensis* Rozeboom, and *paradissimilis* Rozeboom.

*Discussion.*—The species of this subgroup constitute a well-delimited superspecies. Rozeboom (1946) has treated this subgroup fully.



## Subgroup III, PULCHRIVENTER

*Definition.*—Oriental. Basistyle with a scale tuft. Claspette filament bladelike. Male palpi with hairs apically on III, and along IV and V. Female tori scaled. Vertex dorsum mostly narrow scaled. *Ppn* with all broad scales. Postspiracular and paratergite areas scaled.

*Supplementary characters.*—Scutum largely covered with golden scales. Scutellar scales narrow. Subspiracular and prealar areas scaled. Femoral knee spots present. Larval head hairs 5, 6, and 7 in a convex row toward front, 4 slightly posterior and internal to 5, all with several branches. Comb scales numerous, in a patch. Larval habitat: rock pools in stream beds.

*Included species.*—*A. pulchriventer* (Giles).

## Subgroup IV, OREOPHILUS

*Definition.*—Oriental. Basistyle without a scale tuft. Claspette filament bladelike. Male palpi with rather sparse hairs apically on III and along IV and V. Female tori not scaled. Vertex dorsum with narrow scaling. *Ppn* scales nearly all broad and flat. Postspiracular area not scaled. Paratergite scaled.

*Supplementary characters.*—Scutum in female with pale scales arranged in lines, in male entirely covered with pale scales. Scutellar scales narrow. Subspiracular and prealar areas scaled. Femoral knee spots present. Larval head hairs 4, 6, and 7 in a transverse row that is slightly posterior to antennal bases, hair 5 some distance posterior to 6. Median mouthbrush hairs with comblike apices. Comb scales numerous, in a patch. Larval habitat: tree holes.

*Included species.*—*A. oreophilus* (Edwards).

## Subgroup V, SUFFUSUS

*Definition.*—As in Subgroup IV except: Scutum covered with pale scales, a pair of indistinct submedian dark lines present on female. Female tori scaled. Vertex dorsum with narrow scaling. Scutellar scales narrow. *Ppn* with scales on upper part narrow. Postspiracular and prealar areas scaled. Larval head hairs, 4, 6, and 7 in a transverse row slightly posterior to antennal bases, 5 slightly internal and posterior to 6. Median mouthbrush hairs simple. Comb of a few teeth in an irregular row. Larval habitat: tree holes.

*Included species.*—*A. suffusus* Edwards.

## Subgroup VI, GENICULATUS (PROTOMACLEAYA, s. str.)

*Definition.*—Palearctic and Nearctic. Basistyle without a specialized scale clump. Claspette filament slightly broadened (bristle-like in *eatonii*). Male palpi hairy (only a few long hairs in *eatonii*).

Female tori not scaled (female of *eatonii* unknown). Vertex dorsum with narrow scaling. *Ppn* broad scaled, or else narrow scaled at least in part. Postspiracular area with or without scales. Paratergite scaled.

*Supplementary characters*.—Scutal pattern various. Scutellar scales narrow, or partially broad. Subspiracular and prealar areas scaled. Femoral knee spots present. Larval head hair 6 directly anterior to 5, 7 on a line between 5 and 6, 4 anterior to 6. Comb scales few, in a line. Larval habitat: tree holes, and more rarely artificial containers. Larva of *eatonii* unknown.

*Included species*.—*A. eatonii* (Edwards), *echinus* (Edwards), *geniculatus* (Olivier), *triseriatus* (Say) and *t. var. hendersoni* Cockerell.

*Discussion*.—In some respects *eatonii* appears to be more related to Group C, *madagascarensis* in particular, than it does to the other species included here.

#### Subgroup VII. LEUCOCELAENUS (CONOPOSTEGUS)

*Definition*.—Neotropical. Basistyle with a specialized scale tuft. Claspette filament bladelike. Male palpi without hair tufts. Female tori not scaled. Vertex dorsum broad scaled (may be narrow scaled along eye margin and on nape). *Ppn* with broad overlapping white scales. Postspiracular and paratergite areas scaled.

*Supplementary characters*.—Scutum with a large patch of broad silvery scales before the wing base and a median longitudinal band of broad silvery scales. Scutellar lobes clothed with broad flat scales. Subspiracular and prealar areas scaled. Mid- and hind-femora with kneespots; midfemora with an anterior white spot beyond the middle. Larval comb with teeth few, in a line. Larval habitat: tree holes. Larva of *leucotaeniatus* unknown.

*Included species*.—*A. leucocelaenus* Dyar and Shannon and *leucotaeniatus* Komp.

#### CHECKLIST

[An asterisk after the location of the type material indicates that it has been examined by one of us.]

#### Group A (KOCHI-group: FINLAYA, s. str.)

#### *alocasicola* Marks

Queensland; New South Wales

*Aedes* (*Finlaya*) *alocasicola* Marks, 1947. Univ. Queensland Pap., Dept. Biol., vol. 2, pt. 5, p. 35 (male, female, pupa, larva). TYPE: Male (holotype) in University of Queensland.\* TYPE LOCALITY: Australia: Mount Glorius, Queensland (Wassell). HABITAT: Axils of *cunjevoi*.

**ananae** Knight and Laffoon Philippines

*Aedes (Finlaya) ananae* Knight and Laffoon, 1946. Trans. Amer. Ent. Soc., vol. 72, p. 218 (male, female, pupa, larva).  
 TYPE: Male (holotype) in U.S.N.M.\* TYPE LOCALITY: Philippines: Osmena, Basey Municipality, Samar Island (Laffoon).  
 HABITAT: Axils of pandanus, banana, abaca, and pineapple.

**avistylus** Brug Malay Archipelago; Celebes;  
Boeton; Kabaena; Morotai

*Aedes (Finlaya) flavipennis* (Giles) var. *avistyla* Brug, 1939. Tijdsch. v. Ent., vol. 82, p. 107 (male, female, larva). TYPE: Male (holotype) in British Museum.\* TYPE LOCALITY: Boeton: Bae-Bae (Brug). HABITAT: Axils of *Colocasia*; bamboo.

**bougainvillensis** Marks Solomon Islands

*Aedes (Finlaya) bougainvillensis* Marks, 1947. Univ. Queensland Pap., Dept. Biol., vol. 2, pt. 5, p. 19 (male, female, pupa, larva). TYPE: Male (holotype) in University of Queensland.\* TYPE LOCALITY: Solomon Islands: Bougainville Island (Cowell). HABITAT: Axils of lilylike plant, probably *Sararanga*.

**croceus** Knight and Laffoon Philippines

*Aedes (Finlaya) croceus* Knight and Laffoon, 1946. Trans. Amer. Ent. Soc., vol. 72, p. 213 (male, female, pupa, larva). TYPE: Male (holotype) in U.S.N.M.\* TYPE LOCALITY: Philippines: Subic Bay, Zambales Province, Luzon Island (Rozeboom). HABITAT: Axils of banana and taro.

**fijiensis** Marks Fiji

*Aedes (Finlaya) fijiensis* Marks, 1947. Univ. Queensland Pap., Dept. Biol., vol. 2, pt. 5, p. 26 (male, female, larva). TYPE: Male (holotype) in University of Queensland.\* TYPE LOCALITY: Fiji: Samabula (Lever). HABITAT: Axils of pandanus and *Colocasia*.

**flavipennis** (Giles) Philippines

*Finlaya flavipennis* Giles, 1904. Journ. Trop Med., vol. 7, p. 366 (male, female). TYPE: Male and female (cotypes) in British Museum.\* TYPE LOCALITY: Philippines: Camp Stotsenberg, Angeles, Pampanga Province, Luzon Island (Whitmore). HABITAT: Axils of taro, banana, abaca, and pandanus.

*Finlaya arantana* Banks, 1906. Philippine Journ. Sci., vol. 1, p. 1,001 (male, female). TYPE: Male (lectotype) in U.S.N.M.<sup>7</sup>

<sup>7</sup> Banks' cotype series in Manila was destroyed during World War II. A lectotype has therefore been selected at this time from 3 cotypes (1 male, 3 females) deposited by Banks in the U.S.N.M.

**TYPE LOCALITY:** Philippines: Bago, at Mailum and on Siya-Siya Peak, Canloan Volcano, 700 meters, Negros Occidental Province, Negros Island (Banks).

**gahnicola** Marks

Queensland

*Aedes (Finlaya) gahnicola* Marks, 1947. Univ. Queensland Pap., Dept. Biol., vol. 2, pt. 5, p. 43 (male, female, pupa, larva). **TYPE:** Male (holotype) in University of Queensland.\* **TYPE LOCALITY:** Australia: Caloundra, Queensland (Perkins and Wassell). **HABITAT:** Axils of sword grass (*Gahnia*) and pandanus.

**gani** Bonne-Wepster

New Guinea

*Aedes (Finlaya) gani* Bonne-Wepster, 1940. Med. Dienst. Volks. Ned. Ind., vol. 28, p. 158 (male, female). **TYPE:** Male and females (cotypes) in Institute of Tropical Hygiene, Amsterdam.\* **TYPE LOCALITY:** Western New Guinea: Japero (Gani). **HABITAT:** Reared from *Nepenthes*. **REMARKS:** Larva not described.

**knighti** Stone and Bohart

Solomon Islands

*Aedes (Finlaya) knighti* Stone and Bohart, 1944. Proc. Ent. Soc. Washington, vol. 46, p. 210 (male). Female unknown. **TYPE:** Male (holotype) in U.S.N.M.\* **TYPE LOCALITY:** Solomon Islands: Rendova Island, New Georgia group (Downs). **HABITAT:** Larva unknown.

**kochi** (Dönitz)

Queensland; New Guinea; New Britain?;

New Ireland?

*Culex kochi* Dönitz, 1901. Insekten-Börse, vol. 18, p. 38 (female). **TYPE:** Female (holotype) in Zoological Museum, Berlin. **TYPE LOCALITY:** New Guinea. **HABITAT:** Axils of taro, pandanus, crinum, and cunjevoi. **REMARKS:** The type female bears the following label: "Dreyer Hafen b. Cap Cretin. 3.4.00."

**lewelleni** Starkey and Webb

Palau Islands

*Aedes (Finlaya) lewelleni* Starkey and Webb, 1946. Proc. Ent. Soc. Washington, vol. 48, p. 179 (male, female, larva). **TYPE:** Male (holotype) in U.S.N.M.\* **TYPE LOCALITY:** Palau Islands: Angaur Island (Lewellen). **HABITAT:** Axils of pandanus.

**luteus** (Ludlow)

Philippines

*Popea lutea* Ludlow, 1905. Can Ent., vol. 37, p. 96 (female). **TYPE:** Nonexistent. **TYPE LOCALITY:** Philippines: Camp Stotsenberg, Angeles, Pampanga Province, Luzon Island (Whitmore). **HABITAT:** Axils of palm, taro, and banana.



- medleri** Knight and Laffoon Philippines  
*Aedes (Finlaya) medleri* Knight and Laffoon, 1946. Trans. Amer. Ent. Soc., vol. 72, p. 211 (male, female, pupa, larva).  
 TYPE: Male (holotype) in U. S. N. M.\* TYPE LOCALITY: Philippines: Jinamoc Island (Leyte-Samar area) (Medler).  
 HABITAT: Axils of pandanus, banana, taro, and abaca.
- poicilius** (Theobald) Netherlands New Guinea; Simalur; Lombok;  
Java; Sumatra; Celebes; Borneo;  
Malaya; Philippines; Burma; India  
*Finlaya poicilia* Theobald, 1903. Monograph of the Culicidae or mosquitoes, vol. 3, p. 283 (female). TYPE: Female (holotype) in British Museum.\* TYPE LOCALITY: Malay Peninsula: Penang (Freer). HABITAT: Axils of aroid-type plants, banana, abaca, and pandanus.
- samoanus** (Grünberg) Samoa; Tonga  
*Finlaya samoana* Grünberg, 1913. Entomol. Rundschau, vol. 30, p. 130 (female). TYPE: Four females (cotypes) in Zoological Museum, Berlin. TYPE LOCALITY: Samoa: Apia, Upolu (Friederichs). HABITAT: Axils of *Colocasia*, *Alocasia*, and wild araceae.
- solomonis** Stone and Bohart Solomon Islands  
*Aedes (Finlaya) solomonis* Stone and Bohart, 1944. Proc. Ent. Soc. Washington, vol. 46, p. 208 (male, female, larva). TYPE: Male (holotype) in U.S.N.M.\* TYPE LOCALITY: Solomon Islands: Guadalcanal (Lechner). HABITAT: Axils of palms and taro.
- stonei** Knight and Laffoon Philippines  
*Aedes (Finlaya) stonei* Knight and Laffoon, 1946. Trans. Amer. Ent. Soc., vol. 72, p. 208 (male, female, pupa, larva). TYPE: Male (holotype) in U.S.N.M.\* TYPE LOCALITY: Philippines: Ducong, Basey Municipality, Samar Island (Zolik). HABITAT: Axils of banana, pandanus, taro, and abaca.
- wallacei** Edwards New Ireland; New Guinea; New Britain  
*A. (F.) wallacei* Edwards, 1926. Bull. Ent. Res., vol. 17, p. 105 (female). TYPE: Female (holotype) in British Museum.\* TYPE LOCALITY: New Ireland: Kavieng (Kaewung) (Wallace). HABITAT: Axils of banana, taro, pineapples, and pandanus.

## Group B (TERRENS-group: GUALTERIA)

- argyrothorax** Bonne-Wepster and Bonne      Surinam; Brazil  
*Aedes argyrothorax* Bonne-Wepster and Bonne, 1920. Insecutor  
 Inscitiae Menstruus, vol. 7, p. 179, 1919 (male). TYPE: Male  
 (holotype) in U.S.N.M.\* TYPE LOCALITY: Surinam: Para-  
 maribo (Bonne-Wepster). HABITAT: Tree holes. REMARKS:  
 Female, pupa, and larva described by Cerqueira, Proc. Ent. Soc.  
 Washington, vol. 52, p. 173, 1950.
- assamensis** (Theobald) Indo-China; Java; Assam; India; Yunnan  
*Stegomyia assamensis* Theobald, 1908. Rec. Indian Mus., vol. 2,  
 p. 290 (female). TYPE: Female (holotype) in collection of  
 Zoological Survey of India, Calcutta. TYPE LOCALITY: Assam:  
 Sylhet (Hall). HABITAT: Tree holes.
- atropalpus** (Coquillett)      Eastern United States  
*Culex atropalpus* Coquillett, 1902. Can. Ent., vol. 34, p. 292  
 (male, female). TYPE: Male, female (cotypes) in U.S.N.M.\*  
 TYPE LOCALITY: United States: Richmond, Va. (Williams);  
 Plummers Island, Montgomery County, Md. (Currie and Bar-  
 ber); Shenks Ferry, Pa. (Weber); White Mountains, N. H.  
 (Morrison). HABITAT: Rock holes in stream beds. REMARKS:  
 Male, female, and larva are well described by Carpenter, Middle-  
 kauff, and Chamberlain, Mosquitoes of the southern United  
 States, p. 220, 1946.
- atropalpus** var. **epactius** Dyar and Knab      Mexico; Central America  
*Aedes epactius* Dyar and Knab, 1908. Proc. U. S. Nat. Mus., vol.  
 35, p. 53 (male, female). TYPE: Male, female (cotypes) in  
 U. S. N. M.\* TYPE LOCALITY: Mexico: Córdoba and Almoloya,  
 state of Oaxaca (Knab). HABITAT: Rock holes in stream beds.  
 REMARKS: Larva not specifically described.
- Aedes (Culiselsa) perichares* Dyar, 1921. Insecutor Inscitiae  
 Menstruus, vol. 9, p. 36 (male, female). TYPE: Male, female  
 (cotypes) in U. S. N. M.\* TYPE LOCALITY: Costa Rica; Cir-  
 cuelas (Alfaro).
- cacharanus** (Barraud)      Assam; India  
*Finlaya cacharana* Barraud, 1923. Bull Ent. Res., vol. 13, p. 406  
 (male, female). TYPE: Male, female (cotypes) in British Mu-  
 seum.\* TYPE LOCALITY: Assam: Haflong, Cachar Hills (Bar-  
 raud). HABITAT: Tree holes. REMARKS: Larva not described.
- cogilli** Edwards      Southern India  
*Aedes (Finlaya) cogilli* Edwards, 1922. Bull. Ent. Res., vol. 13,

p. 92 (female). TYPE: Females (cotypes) in British Museum.\*  
 TYPE LOCALITY: India: Karwar, northern Kanara (Cogill).  
 HABITAT: Tree holes and bamboos. REMARKS: Larva not described.

**deccanus** (Barraud)

India

*Finlaya deccana* Barraud, 1923. Indian Journ. Med. Res., vol. 11, p. 217 (male, female). TYPE: Male, female (cotypes) in British Museum.\* TYPE LOCALITY: India: Belgaum, Bombay, Deccan (Barraud). HABITAT: Tree holes.

**feegradei** Barraud

Burma

*Aedes (Finlaya) feegradei* Barraud, 1934. Fauna Brit. India, vol. 5, p. 164 (male, female, larva). TYPE: Male, female (cotypes) in British Museum. TYPE LOCALITY: Burma: Rangoon (Feegrade). HABITAT: Tree holes.

**gubernatoris** (Giles)

India

*Culex gubernatoris* Giles, 1901. Journ. Bombay Nat. Hist. Soc., vol. 13, p. 607 (sexes not stated). TYPE: Female (holotype) in British Museum.\* TYPE LOCALITY: India: Allahabad, Government House (Giles). HABITAT: Tree holes. Rock pools?

*Lepidotomyia magna* Theobald, 1905. Genera insectorum, family Culicidae, p. 22 (male, female). TYPE: Male, female (cotypes) in British Museum.\* TYPE LOCALITY: India: Bombay (James).

**gubernatoris** var. **kotiensis** Barraud

Western Himalayas

*Aedes (Finlaya) gubernatoris* (Giles) var. *kotiensis* Barraud, 1934. Fauna Brit. India, vol. 5, p. 161 (male, female, larva). TYPE: Male, female (cotypes) in British Museum. TYPE LOCALITY: Western Himalayas: Koti, near Kalka (Barraud). HABITAT: Tree holes.

**inquinatus** Edwards

Western Himalayas; Nilgiri Hills, India

*Aedes (Finlaya) inquinatus* Edwards, 1922. Indian Journ. Med. Res., vol. 10, p. 267 (male, female). TYPE: Male (holotype) in British Museum.\* TYPE LOCALITY: India: Simla (Christophers). HABITAT: Tree holes. REMARKS: Larva not described.

**khazani** Edwards

India; Indo-China

*Aedes (Finlaya) khazani* Edwards, 1922. Indian Journ. Med. Res., vol. 10, p. 265 (male, female). TYPE: Male (holotype) in British Museum.\* TYPE LOCALITY: India: Pudupadi, Malabar coast (Khazan Chand). HABITAT: Tree holes.

**lophoventralis** (Theobald)

India

*Pseudocarrollia lophoventralis* Theobald, 1910. *Rec. Indian Mus.*, vol. 4, p. 13 (female). **TYPE**: Female (holotype) in collection of Zoological Survey of India, Calcutta. **TYPE LOCALITY**: India: Purniah, Behar (formerly Bengal) (Paiva). **HABITAT**: Tree holes; occasionally artificial containers. **REMARKS**: Pupa and larva described by Sen, *Rec. Indian Mus.*, vol. 40, p. 359, 1938.

**melanopterus** (Giles)

Philippines

*Finlaya melanoptera* Giles, 1904. *Journ. Trop. Med.*, vol. 7, p. 367 (female). **TYPE**: Female (holotype) in British Museum.\* **TYPE LOCALITY**: Philippines: Camp Stotsenberg, Angeles, Pampanga Province, Luzon Island (Whitmore). **HABITAT**: Tree holes. **REMARKS**: Male, larva partially described by King and Hoogstraal, *Journ. Washington Acad. Sci.*, vol. 36, p. 311, 1946. *Popea palawanensis* Ludlow, 1914. *Psyche*, vol. 21, p. 31 (female). **TYPE**: Female (holotype) in U.S.N.M.\* **TYPE LOCALITY**: Philippines: Puerto Princesa, Palawan Island.

**plumiferus** King and Hoogstraal

New Guinea

*Aedes (Finlaya) plumiferus* King and Hoogstraal, 1946. *Journ. Washington Acad. Sci.*, vol. 36, p. 306 (male, female, larva). **TYPE**: Male (holotype) in U.S.N.M.\* **TYPE LOCALITY**: Dutch New Guinea: Hollandia (Nailon). **HABITAT**: Tree holes.

**prominens** (Barraud)

India; Indo-China; China; Celebes

*Finlaya prominens* Barraud, 1923. *Indian Journ. Med. Res.*, vol. 11, p. 228 (male, female). **TYPE**: Male, female (cotypes) in British Museum.\* **TYPE LOCALITY**: India: Sukna, Darjeeling district (Barraud). **HABITAT**: Tree holes and bamboos.

**seoulensis** Yamada

Korea

*Aedes seoulensis* Yamada, 1921. *Annot. Zool. Japon.*, vol. 10, p. 61 (female). **TYPE**: Females (cotypes) in Institute for Infectious Diseases, Tokyo. **TYPE LOCALITY**: Korea: Keijo or Seoul, and Kanko (Hirayama). **HABITAT**: Tree holes and bamboos. **REMARKS**: Male, larva, egg described by Feng, *Chinese Med. Journ.*, Suppl. 2, p. 518, 1938.

**terrens** (Walker)

Mexico to Brazil; Argentina

*Culex terreus* Walker, 1856. *Insecta Saundersiana*, Diptera, vol. 1, p. 429 (male). **TYPE**: Male (holotype) in British Museum (identified as type by Waterhouse). **TYPE LOCALITY**: South America. **HABITAT**: Tree holes and bamboos.



*Aedes (Finlaya) oswaldi*, Lutz, var. *braziliensis* Gordon and Evans, 1922. Ann. Trop. Med. and Parasit., vol. 16, p. 329 (male). TYPE: Male (2 cotypes) in Liverpool School of Tropical Medicine. TYPE LOCALITY: Brazil: Macapa, 15 miles from Manáos on Rio Negro (Gordon).

*Gualteria Oswaldi* Lutz, 1904. In Bourroul, Mosquitos do Brasil, p. 47 (sex not given). TYPE: Nonexistent. TYPE LOCALITY: Brazil: Rio de Janeiro. Minas e São Paulo. REMARKS: On p. 47 no definition is given; on p. 66 the combination is *Haemagogus Oswaldi* Lutz, and here a definition is given.

**terrens var. metoecopus Dyar**

Ecuador

*Aedes metoecopus* Dyar, 1925. Insecutor Inscitiae Menstruus, vol. 13, p. 30 (male, female). TYPE: Male, female (cotypes) in U.S.N.M.\* TYPE LOCALITY: Ecuador: F. Campos R. HABITAT: ? REMARKS: Larva undescribed.

**terrens var. podographicus Dyar and Knab** Mexico, Central America, Venezuela

*Aedes podographicus* Dyar and Knab, 1906. Proc. Biol. Soc. Washington, vol. 19, p. 165 (male, female). TYPE: Male, female (cotypes) in U.S.N.M.\* TYPE LOCALITY: Salvador: San Antonio, west of Sonsonate (Knab). HABITAT: Tree holes and bamboos.

*Aedes (Finlaya) heteropus* Dyar, 1921. Insecutor Inscitiae Menstruus, vol. 9, p. 152 (male, female). TYPE: Male, female (cotypes) in U.S.N.M.\* TYPE LOCALITY: Costa Rica: Alajuela (Alfaro).

*Aedes terreus homoeopus* Dyar, 1922. Insecutor Inscitiae Menstruus, vol. 10, p. 92 (male). TYPE: Males (cotypes) in U.S.N.M.\* TYPE LOCALITY: Costa Rica: Alajuela (Alfaro). REMARKS: The Knab specimens from Cordoba, Mexico, are not labeled types.

*Verrallina insolita* Coquillett, 1906. Can. Ent., vol. 38, p. 62 (female). TYPE: Female (holotype) in U.S.N.M.\* TYPE LOCALITY: West Indies: Trinidad (Urich).

*Verrallina laternaria* Coquillett, 1906. Proc. Ent. Soc. Washington, vol. 7, p. 184 (male). TYPE: Male (holotype) in U.S.N.M.\* TYPE LOCALITY: West Indies: Trinidad (Busck).

**thorntoni Dyar and Knab**

Nicaragua; ?Panama; ?Brazil

*Aedes thorntoni* Dyar and Knab, 1907. Journ. New York Ent. Soc., vol. 15, p. 10 (female). Male not known from Nicaragua. TYPE: Females (cotypes) in U.S.N.M.\* TYPE LOCALITY: Nicaragua: Bluefields (Thornton). HABITAT: Tree holes. RE-

MARKS: Larva not known from Nicaragua. It is doubtful that material recorded from Panama by authors is conspecific.

**tsiliensis** King and Hoogstraal

New Guinea

*Aedes (Finlaya) tsiliensis* King and Hoogstraal, 1946. Journ. Washington Acad. Sci., vol. 36, p. 305 (male). Female unknown. TYPE: Male (holotype) in U.S.N.M.\* TYPE LOCALITY: New Guinea: Tsili Tsili on the Watut River, a branch of the Markham River (King). HABITAT: Tree hole. REMARKS: Larva not described.

**unicinctus** Edwards

Western and eastern Himalayas

*Aedes (Finlaya) unicinctus* Edwards, 1922. Indian Journ. Med. Res., vol. 10, p. 266 (male). TYPE: Male (holotype) in British Museum.\* TYPE LOCALITY: India: Simla (Christophers). HABITAT: Tree holes. REMARKS: Female, larva, described by Barraud, Fauna British India, Diptera, vol. 5, p. 170, 1934.

**watasei** Yamada

Japan

*Aedes watasei* Yamada, 1921. Annot. Zool. Japon., vol. 10, p. 64 (female). Male undescribed. TYPE: Female (holotype) in the Institute for Infectious Diseases, Tokyo. TYPE LOCALITY: Japan: Omura, Kiushu (Yamada). HABITAT: Not given. REMARKS: Larva described (? *watasei*) by LaCasse and Yamaguti, Mosquitoes of Japan, pt. 2, p. 80, 1947.

Group C (LONGIPALPIS-group)

**barnardi** Edwards

South Africa

*Aedes (Finlaya) barnardi* Edwards, 1924. Ann. South African Mus., vol. 19, p. 161 (female). Male unknown. TYPE: Female (cotypes) in Capetown and British Museum.\* TYPE LOCALITY: Africa: Oudebosch, Cape Province (Barnard). HABITAT: ? REMARKS: Larva unknown.

**embuensis** Edwards

Kenya

*Aedes (Finlaya) embuensis* Edwards, 1930. Bull. Ent. Res., vol. 21, p. 295 (female). TYPE: Female (holotype) in British Museum.\* TYPE LOCALITY: Africa: Embu, Kenya (Orde-Browne). HABITAT: Tree holes. REMARKS: Larva undescribed. Male and pupa described by van Someren, Proc. Roy. Ent. Soc. London, ser. B, vol. 16, p. 130, 1947.

**fulgens** (Edwards)

East Africa; northern Rhodesia

*Ochlerotatus (F.) fulgens* Edwards, 1917. Bull. Ent. Res., vol. 7, p. 213 (male, female). TYPE: Male (holotype) in British

**Museum.\* TYPE LOCALITY:** Africa: Zanzibar (Aders). **HABITAT:** Tree holes and rock pools. **REMARKS:** Larva described by Hopkins, Bull. Ent. Res., vol. 33, p. 176, 1942. Pupa by De Meillon, Parent, and Black, Bull. Ent. Res., vol. 36, p. 99, 1945.

**ingrami** Edwards      West Africa; Kenya; Uganda; Nyasaland  
*Aedes (Finlaya) ingrami* Edwards, 1930. Bull. Ent. Res., vol.  
21, p. 296 (male, female). TYPE: Female (holotype) in British  
Museum.\* TYPE LOCALITY: Africa: Aburi, Gold Coast (In-  
gram). HABITAT: Tree holes and bamboos.

**longipalpis** (Grünberg) West Africa  
*Stegomyia longipalpis* Grünberg, 1905. Zool. Anz., vol. 29, p. 383  
 (female). TYPE: Two females (cotypes) in Zoological Museum,  
 Berlin. TYPE LOCALITY: Africa: Duala, Cameroons (Jupitza).  
 HABITAT: Tree holes and bamboos. REMARKS: Larva described  
 by Hopkins, Bull. Ent. Res., vol. 33, p. 176, 1942.  
*Stegomyia pollinator* Graham, 1910. Ann. Mag. Nat. Hist., ser.  
 8, vol. 5, p. 271 (male, female). TYPE: Female (holotype) in  
 British Museum.\* TYPE LOCALITY: Africa: Lagos, Nigeria  
 (Graham).

**madagascarensis** van Someren Madagascar  
*Aedes (Finlaya) madagascarensis* van Someren, 1949. Proc.  
 Roy. Ent. Soc. London, ser. B, vol. 18, p. 7 (female). Male  
 unknown. TYPE: Female (holotype, but labeled allotype) in  
 British Museum.\* TYPE LOCALITY: Madagascar: Sakaramy,  
 near Diego Suarez. HABITAT: ? REMARKS: Larva unknown.

**monetus** Edwards Madagascar  
*Aedes (Finlaya) monetus* Edwards, 1935. Bull. Ent. Res., vol.  
 26, p. 132 (female). Male unknown. TYPE: Female (holo-  
 type) in British Museum.\* TYPE LOCALITY: Madagascar: Mae-  
 vatanane (Lamborn). HABITAT: ? REMARKS: Larva unknown.

**nyasae** Edwards Nyasaland  
*Aedes (Finlaya) nyasae* Edwards, 1930. Bull. Ent. Res., vol. 21,  
p. 296 (male, female). TYPE: Female (holotype) in British  
Museum.\* TYPE LOCALITY: Africa: Fort Johnston, Nyasaland  
(Lamborn). HABITAT: Tree holes. REMARKS: Larva not de-  
scribed.

**phillipi** van Someren Madagascar  
*Aëdes (Finlaya) phillipi* van Someren, 1949. Proc. Roy. Ent.  
 Soc. London, ser. B, vol. 18, p. 7 (male). Female unknown.

TYPE: Male (holotype) in British Museum.\* TYPE LOCALITY: Madagascar: Sakaramy, near Diego Suarez. HABITAT: Tree holes. REMARKS: Larva not described.

**pulchrithorax** Edwards

Kenya

*Aedes (Finlaya) pulchrithorax* Edwards, 1939. Proc. Roy. Ent. Soc., ser. B, vol. 8, p. 17 (sexes not given). TYPE: Male (holotype) and female (allotype) in British Museum.\* TYPE LOCALITY: Africa: Nairobi, Kenya (MacDonald). HABITAT: Tree holes. REMARKS: Larva described by MacDonald, Proc. Roy. Ent. Soc., ser. B, vol. 8, p. 17, 1939.

**wellmanii** (Theobald)

Angola

*Danielsia wellmanii* Theobald, 1905. Entomologist, vol. 38, p. 103 (female). TYPE: Female (holotype) in British Museum.\* TYPE LOCALITY: Africa: Bihe, Angola (Wellmann). HABITAT: ? REMARKS: Male and larva described by Robinson, Journ. Ent. Soc. Southern Africa, vol. 11, p. 66, 1948.

Group D (AUREOSTRIATUS-group: HULECOETEOMYIA)

**abadsantosi** Baisas

Philippines

*Aedes (Finlaya) abadsantosi* Baisas, 1946. Philippine Month. Bull. Bur. Health, vol. 22, p. 25 (male, female, pupa, larva). TYPE: Male (holotype) in Philippine Bureau of Health, Manila.\* (Male genitalia examined). TYPE LOCALITY: Philippines: Llavac, Infanta Municipality, Luzon Island (Baisas). HABITAT: Rock holes in stream beds.

**aureostriatus** (Doleschall)

Sumatra; Java; Celebes; Kabaena;  
Alor; Soembawa; Timor; Ceram;  
Amboina; Dutch New Guinea

*Culex aureostriatus* Doleschall, 1851. Nat. Tijdschr. Nederl.-Ind., vol. 14, p. 385 (female). Male not specifically described. TYPE: Nonexistent. TYPE LOCALITY: Amboina. HABITAT: Tree holes. REMARKS: Larva not described.

**aureostriatus** var. **greenii** (Theobald)<sup>\*</sup>

India; Ceylon; Assam;  
Sumatra; Java

*Howardina Greenii* Theobald, 1903. A monograph of the Culicidae or Mosquitoes, vol. 3, p. 289 (female). TYPE: Female (holotype) in British Museum.\* TYPE LOCALITY: Ceylon: Peradeniya (Green). HABITAT: Tree holes and bamboos.

\* Varietal status used, following Edwards, in Barraud, Fauna British India, Diptera, vol. 5, p. 442, 1934.



REMARKS: Male and larva described in Barraud, Fauna Brit. India, Diptera, vol. 5, p. 184, 1934.

**aureostriatus** var. **kanaranus** (Barraud) India

*Finlaya greeni* (Theo.) var. *Ranarana* Barraud, 1924. Indian Journ. Med. Res., vol. 11, p. 850 (male, female). TYPE: Female (holotype), in British Museum according to Barraud (1934) but it has not been located there. TYPE LOCALITY: India: Karwar, northern Kanara (Barraud). HABITAT: ? Tree holes and bamboos. REMARKS: Larva not specifically described.

*Aedes* (*Finlaya*) *greeni* (Theobald) var. *kanaranus* Barraud, 1934. Fauna British India, Diptera, vol. 5, p. 185. Emendation.

**burgosi** Baisas Philippines

*Aedes* (*Finlaya*) *burgosi* Baisas, 1946. Philippine Month. Bull. Bur. Health, vol. 22, p. 27 (male, female, pupa, larva). TYPE: Male (holotype), genitalia in Philippine Bureau of Health, Manila. Remainder nonexistent. TYPE LOCALITY: Philippines: Titunod Creek, in Kolambagan, Lanao, Mindanao Island (Guinto). HABITAT: Rock holes in stream beds.

**candidoscutellum** Marks Queensland, New South Wales; New Guinea

*Aedes* (*Finlaya*) *candidoscutellum* Marks, 1947. Univ. Queensland Pap., Dept. Biol., vol. 2, pt. 6, p. 1 (male, female, pupa, larva). TYPE: Female (holotype) in University of Queensland.\* TYPE LOCALITY: Australia: Binna Burra, Lamington National Park, Queensland (Perkins). HABITAT: Tree holes and a rock pool.

**chrysolineatus** (Theobald) India; Siam; Malaya; Indo-China; Java; Sumatra

*Howardina chrysolineata* Theobald, 1907. A monograph of the Culicidae or mosquitoes, vol. 4, p. 218 (female). TYPE: Female (holotype) in British Museum.\* TYPE LOCALITY: Ceylon: Pundabroya (Pundaluoya) (Green). HABITAT: Tree holes, rock holes in stream beds, bamboos, *Colocasia*, and occasionally artificial containers.

*Hulecoeteomyia trilineata* Leicester, 1904 (nec Theobald, 1901). In Theobald, Entomologist, vol. 27, p. 163 (male, female). TYPE: Male, female (cotypes) in British Museum.\* TYPE LOCALITY: Malaya: Kuala Lumpur (Leicester).



*Aedes (Finlaya) eucleptes* Dyar, 1921. Insecutor Inscitiae Menstruus, vol. 9, p. 147 (male, female). TYPE: Male holotype) in U.S.N.M.\* TYPE LOCALITY: China: Canton (Howard).

**jugraensis** (Leicester) Malaya  
*Helecoctemyia jugraensis* Leicester, 1908. Culicidae of Malaya, p. 109 (male, female). TYPE: Male, female (cotypes), non-existent. TYPE LOCALITY: Malaya: Jugra (Leicester). HABITAT: Water collected in fallen forest leaves.

**keefei** King and Hoogstraal New Guinea; northern Queensland  
*Aedes (Finlaya) keefei* King and Hoogstraal, 1946. Journ. Washington Acad. Sci., vol. 36, p. 311 (male, female, larva). TYPE: Female (holotype) in U.S.N.M.\* TYPE LOCALITY: New Guinea: K. B. Mission, Milne Bay, Papua. HABITAT: Tree holes.

**koreicus** (Edwards) Korea; China; Japan  
*Ochlerotatus (F.) koreicus* Edwards, 1917. Bull. Ent. Res., vol. 7, p. 212 (male, female). TYPE: Male (holotype) in British Museum.\* TYPE LOCALITY: Korea (Mills). HABITAT: Rock pools and artificial containers.

**okinawanus** Bohart Okinawa  
*Aedes (Finlaya) okinawanus* Bohart, 1946. Proc. Biol. Soc. Washington, vol. 59, p. 39 (male, female, larva). TYPE: Male (holotype) in U.S.N.M.\* TYPE LOCALITY: Okinawa: Okuma (Harnage). HABITAT: Tree holes.

**pallirostris** Edwards Assam  
*Aedes (Finlaya) pallirostris* Edwards, 1922. Indian Journ. Med. Res., vol. 10, p. 270 (female). Male unknown. TYPE: female (holotype) in British Museum.\* TYPE LOCALITY: Assam: Golaghat, Sibsagar district (Christophers). HABITAT: Bamboos. REMARKS: Larva not described.

**quasirubithorax** (Theobald) Queensland; New South Wales;  
New Guinea  
*Culex quasirubithorax* Theobald, 1910. A monograph of the Culicidae or Mosquitoes, vol. 5, p. 348 (female). TYPE: Female (holotype) in British Museum.\* TYPE LOCALITY: Australia: Kuranda, Queensland (Bancroft). HABITAT: Tree holes, a concrete well, and a rock pool. REMARKS: Male, larva are described by King and Hoogstraal, Journ. Washington Acad. Sci., vol. 36, p. 313, 1946.

- rizali** (Banks) Philippines  
*Culex rizali* Banks, 1906. Philippine Journ. Sci., vol. 1, p. 999 (female). Male unknown. TYPE: Female (holotype), non-existent. TYPE LOCALITY: Philippines: Canlaon Volcano, Mount Siya-Siya, 760 meters, Negros Occidental Province, Negros Island (Banks). HABITAT: Larva unknown.
- saxicola** Edwards Sumatra; Java; Malaya; Siam; Philippines; India; Assam  
*Aedes* (*Finlaya*) *saxicola* Edwards, 1922. Indian Journ. Med. Res., vol. 10, p. 466. New name for *fluviatilis* Leicester. HABITAT: Rock holes in stream beds. ?Tree hole.  
*Hulecoeteomyia fluviatilis* Leicester, 1908 (nec Lutz, 1904). Culicidae of Malaya, p. 111 (male, female). TYPE: Non-existent. TYPE LOCALITY: Malay Peninsula: Ulu Gombak (Leicester).  
*Finlaya greigi* Barraud, 1923. Bull. Ent. Res., vol. 13, p. 406 (male, female). TYPE: Male, female (cotypes) in British Museum.\* TYPE LOCALITY: Assam: Haflong, Cachar Hills (Barraud).
- scutellalbum** Boshell-Manrique South America; Colombia  
*Aedes* (*Finlaya*) *scutellalbum* Boshell-Manrique, 1939. Rev. Ent., vol. 10, p. 309 (male, female, larva). TYPE: Male (holotype) in U.S.N.M.\* TYPE LOCALITY: South America: Río Upin, Municipality of Restrepo, Intendencia del Meta, Colombia (Hernandez). HABITAT: Rock pools in stream beds.
- sherki** Knight Philippines  
*Aedes* (*Finlaya*) *sherki* Knight, 1947. Ann. Ent. Soc. Amer., vol. 40, p. 645 (male, female, larva). TYPE: Male (holotype) in U.S.N.M.\* TYPE LOCALITY: Philippines: Baguio, city of Baguio Province, Luzon Island (Rozeboom). HABITAT: Rock holes in stream beds. Occasionally artificial containers.
- sintoni** (Barraud) Kashmir; western Himalayas  
*Finlaya sintoni* Barraud, 1924. Indian Journ. Med. Res., vol. 11, p. 967 (male, female). TYPE: Male (holotype) in British Museum.\* TYPE LOCALITY: India: Ferozepore Nullah, near Tangmarg, Kashmir, over 7,000 feet (Sinton). HABITAT: Rock pools in stream beds. REMARKS: Larva not described.
- togoi** (Theobald) Japan; China; eastern Siberia  
*Culicelsa togoi* Theobald, 1907. A monograph of the Culicidae or mosquitoes, vol. 4, p. 379 (female). TYPE: Female (holotype) in the British Museum.\* TYPE LOCALITY: Japan: Osaka.



HABITAT: Artificial containers and rock pools. Fresh or saline water, near seacoast. REMARKS: Male, larva described by Bohart and Ingram, NavMed, No. 1055, p. 66, 1946.

**wasselli Marks**

Queensland

*Aedes (Finlaya) wasselli* Marks, 1947. Univ. Queensland Pap., Dept. Biol., vol. 2, pt. 6, p. 9 (female). Male unknown. TYPE: Female (holotype) in University of Queensland.\* TYPE LOCALITY: Australia: Mountain Creek, at southern foot of Buderim Mountain, southern Queensland (Wassell). HABITAT: ? REMARKS: Larva unknown.

**Group E (MEDIOVITTATUS group: GYMNOMETOPA)**

**albilabris Edwards**

Solomon Islands

*Aedes (Finlaya) albilabris* Edwards, 1925. Bull. Ent. Res., vol. 15, p. 258 (female). Male described by Edwards, Bull. Ent. Res., vol. 17, p. 110, 1926. TYPE: Female (holotype) in British Museum.\* TYPE LOCALITY: Solomon Islands: Tulagi Island (Carment). HABITAT: Tree holes. REMARKS: Larva described by Paine and Edwards, Bull. Ent. Res., vol. 20, p. 315, 1929.

**banksi Edwards**

Philippines

*Aedes (Finlaya) banksi* Edwards, 1922. Indian Journ. Med. Res., vol. 10, p. 270 (male, female). TYPE: Male (holotype) in British Museum.\* TYPE LOCALITY: Philippines: Montalban, Rizal (Banks). HABITAT: Rock holes in stream bed. REMARKS: Larva not described.

**elsiae (Barraud)**

Assam; Cochinchina; China

*Finlaya elsiae* Barraud, 1923. Bull. Ent. Res., vol. 13, p. 406 (male, female). TYPE: Male, female (cotypes) in British Museum.\* TYPE LOCALITY: Assam: Shillong, Khasi Hills (Barraud). HABITAT: Rock pools and tree hole.

*Aedes (Finlaya) simulatus* Barraud, 1931. Indian Journ. Med. Res., vol. 19, p. 611 (female). TYPE: Female (holotype) in Malaria Survey Institute collection, Kasauli, India. TYPE LOCALITY: Assam: Haflong, Cachar Hills (Barraud).

**hatorii Yamada**

Formosa

*Aedes hatorii* Yamada, 1921. Annot. Zool. Japon., vol. 10, p. 70 (male). Female undescribed. TYPE: Male (holotype) in Institute for Infectious Diseases, Tokyo. TYPE LOCALITY: Formosa: Taihoku (Hatori). HABITAT: ? REMARKS: Larva unknown.

**hegneri** Causey

Siam

*Aedes (Finlaya) hegneri* Causey, 1937. Journ. Parasitol., vol. 23, p. 543 (male, female). TYPE: Male (holotype), stated as being in U. S. N. M. but has not been deposited there. TYPE LOCALITY: Siam: Chang (Causey). HABITATS: Rock pools. REMARKS: Larva undescribed.

**macdougalli** Edwards

Ceylon; India; Java; Sumatra

*Aedes (Finlaya) macdougalli* Edwards, 1922. Indian Journ. Med. Res., vol. 10, p. 271 (male, female). TYPE: Male (holotype) in British Museum.\* TYPE LOCALITY: Ceylon: Diyatalawa (MacDougall). HABITAT: Bamboos and rock pools.

**macfarlanei** (Edwards)

Hong Kong; Cochinchina; Sumatra

*Ochlerotatus macfarlanei* Edwards, 1914. Bull. Ent. Res., vol. 5, p. 78 (male, female). TYPE: Male (holotype) in British Museum.\* TYPE LOCALITY: Hong Kong (Macfarlane). HABITAT: Rock pools in stream beds. REMARKS: Larva described in Barraud, Fauna British India, Diptera, vol. 5, p. 181, 1934.

**mallochi** Taylor

Queensland; New South Wales

*Aedes (Finlaya) mallochi* Taylor, 1944. Proc. Linn. Soc. New South Wales, vol. 69, p. 121 (female). Male undescribed. TYPE: Female (neotype) in School of Public Health and Tropical Medicine, University of Sydney.\* TYPE LOCALITY: Australia: Eidsvold (Brancroft). HABITAT: Tree hole. REMARKS: Larva undescribed. No types were designated by Taylor. Therefore, a female specimen from the type location has been designated neotype at this time.

**mediovittatus** (Coquillett)

Antilles; Virgin Islands; Venezuela

*Stegomyia mediovittata* Coquillett, 1906. Can. Ent., vol. 38, p. 60 (male, female). TYPE: Male, female (cotypes) in U.S.N.M.\* TYPE LOCALITY: West Indies: San Domingo (Busck). HABITAT: Tree holes and artificial containers. REMARKS: Larva described by Dyar, Mosquitoes of America, p. 227, 1928.

*Aedes uncatatus* Grabham, 1907. Can. Ent., vol. 39, p. 25 (male, female, larva). TYPE: Male, female (cotypes) in U.S.N.M.\* TYPE LOCALITY: Jamaica: Kingston (Grabham).

**notoscriptus** (Skuse)

Australia; New Zealand; New Caledonia;

New Guinea; New Britain

*Culex notoscriptus* Skuse, 1889. Proc. Linn. Soc. New South Wales, vol. 3, p. 1738 (male, female). Male described by Brug, Bull. Ent. Res., vol. 25, p. 513, 1934. TYPE: Male, female (co-

types) in Macleay Museum, University of Sydney. TYPE LOCALITY: Australia: Sydney, New South Wales (Masters and Skuse). HABITAT: Tree holes, rock pools, fallen palm fronds, and artificial containers. REMARKS: Larva described by Lee. An atlas to the mosquito larvae of the Australasian region, p. 57, 1944.

**notoscriptus** var. **montanus** Brug Java

*Aedes* (*Finlaya*) *notoscriptus* (Skuse) var. *montana* Brug, 1939. Tijdschr. Ent., vol. 82, p. 104 (male). Female not described. TYPE: Male (holotype) in British Museum.\* TYPE LOCALITY: Java: Lembang, 1,250 meters (Brug). HABITAT: Tree hole. REMARKS: Larva not described.

**pseudotaeniatus** (Giles) India; Assam; Burma; Ceylon

*Culex pseudotaeniatus* Giles, 1901. Journ. Bombay Nat. Hist. Soc., vol. 13, p. 607 (sexes not stated). TYPE: Male, female (cotypes) in British Museum.\* TYPE LOCALITY: India: Naimi Tal, 7,000 feet (Giles). HABITAT: Tree holes, rock pools, and artificial containers.

**quinquelineatus** Edwards Queensland

*Aedes* (*Finlaya*) *quinquelineatus* Edwards, 1922. Bull. Ent. Res., vol. 13, p. 93 (female). Male unknown. TYPE: Female (holotype) in British Museum.\* TYPE LOCALITY: Australia: Queensland (Bancroft). HABITAT: ? REMARKS: Larva unknown.

**shortti** (Barraud) Kashmir; Assam; Sumatra

*Finlaya shortti* Barraud, 1923. Bull. Ent. Res., vol. 13, p. 405 (male, female). TYPE: Male, female (cotypes) in British Museum.\* TYPE LOCALITY: Assam: Shillong, Khasi Hills (Barraud). HABITAT: Rock pools.

Group F (ALBOANNULATUS-group: DANIELSIA)

**alboannulatus** (Macquart) Australia

*Culex albo-annulatus* Macquart, 1849. Diptères exotiques nouveaux ou peu connus, Suppl. 4, p. 10 (female); Mémoires, p. 314, 1850. Male described by Theobald, A monograph of the Culicidae or mosquitoes, vol. 1, p. 391, 1901. TYPE: Location unknown. TYPE LOCALITY: Australia. HABITAT: Ground and rock pools, occasionally in brackish marshes. REMARKS: Larva described by Lee, Atlas of mosquito larvae of the Australasian region, p. 60, 1944.

- albocinctus** (Barraud) Yunnan; Western Himalayas  
*Finlaya albocincta* Barraud, 1924. Indian Journ. Med. Res., vol. 11, p. 1002 (male, female). TYPE: Male, female (cotypes in British Museum.\* TYPE LOCALITY: India: Solan, western Himalayas, 4,000 feet (Barraud). HABITAT: Tree holes.
- albotaeniatus** (Leicester) India; Malaya; Sumatra  
*Danielsia albotæniata* Leicester, 1904. In Theobald, Entomologist, vol. 37, p. 111 (male, female). TYPE: Male, female (cotypes) in British Museum.\* TYPE LOCALITY: Malay Peninsula: Kuala Lumpur (Leicester). HABITAT: Bamboos. REMARKS: Larva not completely described.
- albotaeniatus** var. **mikiranus** Edwards Yunnan; India; Assam  
*Aedes (Finlaya) mikiranus* Edwards, 1922. Indian Journ. Med. Res., vol. 10, p. 269 (female). Male not specifically described. TYPE: Female (holotype) in British Museum.\* TYPE LOCALITY: Assam: Mikir Hills, Sibsagar district (Christophers). HABITAT: Bamboos. REMARKS: Larva not described.
- alektorovi** Stackelberg Siberia  
*Aedes (Finlaya) alektorovi* Stackelberg, 1943. Bull. Ent. Res., vol. 34, p. 311 (male). Female unknown. TYPE: Male holotype) in Zoological Institute, Academy of Sciences, Leningrad. TYPE LOCALITY: Southeastern Siberia: Kamenushka, district of Shkotovo, Ussuri Land (Montshadsky). HABITAT: ? REMARKS: Larva unknown.
- alticola** Bonne-Wepster New Guinea  
*Aedes (F.) alticola* Bonne-Wepster, 1948. Treubia, vol. 19, p. 313 (female). Male unknown. TYPE: Female (holotype) in Institute of Tropical Hygiene, Amsterdam.\* TYPE LOCALITY: Dutch New Guinea: Scree Valley at foot of Mount Wilhelm, 3,800 meters (Toxopeus). HABITAT: ? REMARKS: Larva unknown.
- anggiensis** Bonne-Wepster New Guinea  
*Aedes (Finlaya) anggiensis* Bonne-Wepster, 1937. Med. Dienst Volks. Ned.-Ind., vol. 26, p. 97 (male, female). TYPE: Male, female (cotypes) in Institute of Tropical Hygiene, Amsterdam.\* TYPE LOCALITY: Dutch New Guinea: Anggi Lakes, 2,000 meters. HABITAT: ? REMARKS: Larva unknown.
- argenteitarsis** Brug New Guinea  
*Aedes (Finlaya) argenteitarsis* Brug, 1932. Bull. Ent. Res., vol. 23, p. 76 (female). TYPE: Female (holotype) in British Museum.\* TYPE LOCALITY: Dutch New Guinea: Upper Digoel River (de Rook). HABITAT: Fallen leaves.



- auridorsum** Edwards Queensland  
*Aedes (Finlaya) auridorsum* Edwards, 1922. Bull. Ent. Res., vol. 12, p. 93 (male, female). TYPE: Female (holotype) in British Museum.\* TYPE LOCALITY: Australia: Eidsvold, Queensland (Bancroft). HABITAT: Tree holes. REMARKS: Pupa and larva described by Marks, Univ. Queensland Pap., Dept. Biol., vol. 2, pt. 8, p. 24, 1948.
- auronitens** Edwards Western Himalayas  
*Aedes (Finlaya) auronitens* Edwards, 1922. Indian Journ. Med. Res., vol. 10, p. 268 (male, female). TYPE: Male (holotype) in British Museum.\* TYPE LOCALITY: India: Simla (Christophers). HABITAT: Tree holes.
- australiensis** (Theobald) Queensland  
*Leucomyia australiensis* Theobald, 1910. A monograph of the Culicidae or mosquitoes, vol. 5, p. 313 (female). Male unknown. TYPE: Female (holotype) in British Museum.\* TYPE LOCALITY: Australia: Stannary Hills, Queensland (Bancroft). HABITAT: Tree holes. REMARKS: Pupa and larva described by Marks, Univ. Queensland Pap., Dept. Biol., vol. 2, pt. 8, p. 3, 1948.
- biocellatus** (Taylor) New South Wales; Queensland  
*Culex biocellatus* Taylor, 1914. Proc. Linn. Soc. New South Wales, vol. 39, p. 463 (female). TYPE: Female (holotype) in School of Public Health and Tropical Medicine, University of Sydney.\* TYPE LOCALITY: Australia: Hawkesbury River, Milson Island, New South Wales (Cleland). HABITAT: Tree and stump holes. REMARKS: Male, pupa, and larva described by Marks, Univ. Queensland Pap., Dept. Biol., vol. 2, pt. 8, p. 6, 1948.
- christophersi** Edwards Kashmir; Himalayas  
*Aedes (Finlaya) christophersi* Edwards, 1922. Indian Journ. Med. Res., vol. 10, p. 267 (female). TYPE: Female (holotype) in British Museum.\* TYPE LOCALITY: India: Simla (Christophers). HABITAT: Tree holes.
- clintoni** Taylor New Guinea  
*Aedes (Finlaya) clintoni* Taylor, 1946. Proc. Linn. Soc. New South Wales, vol. 70, p. 211 (male). Female unknown. TYPE: Male (holotype) in School of Public Health and Tropical Medicine, University of Sydney. TYPE LOCALITY: New Guinea: Lae, Territory of New Guinea (Clinton). HABITAT: ? REMARKS: Larva unknown.

**derooki Brug**

Moluccas

*Aedes (Finlaya) derooki* Brug, 1932. Bull. Ent. Res., vol. 23, p. 75 (female). Male unknown. TYPE: Female (holotype) in British Museum.\* TYPE LOCALITY: Dutch East Indies: Ternate, Moluccas (de Rook). HABITAT: Rock pools in stream bed. REMARKS: Larva not described.

**dobodurus King and Hoogstraal**

New Guinea

*Aedes (Finlaya) dobodurus* King and Hoogstraal, 1946. Proc. Ent. Soc. Washington, vol. 48, p. 37 (male, female, larva). TYPE: Female (holotype) in U. S. N. M.\* TYPE LOCALITY: New Guinea: Dobodura (Monlux). HABITAT: Fallen leaves, cup fungi, and artificial containers.

**fengi Edwards**

China

*Aedes (Finlaya) fengi* Edwards, 1935. Bull. Ent. Res., vol. 26, p. 131 (male, female). TYPE: Male (holotype) in British Museum.\* TYPE LOCALITY: Central China: Muganshan, Chekiang (Feng). HABITAT: Bamboo stumps. REMARKS: Larva described by Li and Wu, 1934 Year Book Bur. Ent. (Hangchow), vol. 4, p. 96, 1935.

**fluviatilis (Lutz)**

Brazil; Guianas

*Culex fluviatilis* Lutz, 1904. In Bourroul, Mosquitos do Brasil, p. 72 (sexes not given). TYPE: Nonexistent. TYPE LOCALITY: Brazil: Rio Grande, near Franca, Rio Mogy Guassú. HABITAT: Rock holes in stream courses. REMARKS: Male, female, larva described by Dyar, Mosquitoes of America, p. 219, 1928.

*Aedes draconarius* Dyar, 1922. Insecutor Inscitiae Menstruus, vol. 10, p. 194 (male, female). TYPE: Male, female (cotypes) in U. S. N. M.\* TYPE LOCALITY: South America: Saint Laurent, Maroni River, French Guiana (Brimont).

*Danielsia mediomaculata* Theobald, 1907. A monograph of the Culicidae or mosquitoes, vol. 4, p. 245 (male, female). TYPE: ? in British museum. TYPE LOCALITY: South America: Pará, Brazil (Goeldi).

*Danielsia tripunctata* Theobald, 1907. A monograph of the Culicidae or mosquitoes, vol. 4, p. 247 (female). TYPE: Female (holotype) in British Museum. TYPE LOCALITY: South America: Rio Grande, Brazil (Lutz).

**gilli (Barraud)**

Western Himalayas

*Finlaya gilli* Barraud, 1924. Indian Journ. Med. Res., vol. 11, p. 1000 (male, female). TYPE: Male, female (cotypes) in

British Museum.\* **TYPE LOCALITY:** India: Krol Mountain, near Solan (Kalka-Simla road), 7,000 feet (Barraud).  
**HABITAT:** Tree holes.

**harperi** Knight Philippines

*Aedes (Finlaya) harperi* Knight, 1948. Proc. Ent. Soc. Washington, vol. 50, p. 4 (male, female, larva). **TYPE:** Male (holotype) in U. S. N. M.\* **TYPE LOCALITY:** Philippines: Ziz Zag Pass, Subic Bay, Zambales Province, Luzon (Rozeboom and MacMillan). **HABITAT:** Bamboos.

**hollandius** King and Hoogstraal New Guinea

*Aedes (Finlaya) hollandius* King and Hoogstraal, 1946. Proc. Ent. Soc. Washington, vol. 48, p. 38 (male, female). **TYPE:** Female (holotype) in U.S.N.M.\* **TYPE LOCALITY:** Dutch New Guinea: Mount Dafonsoero, Cyclops Range, Hollandia area, 4,600 feet (Fullem and Cook). **HABITAT:** Fallen leaves, tree holes, rock pool, and artificial containers.

**knabi** (Coquillett) Mexico

*Culex knabi* Coquillett, 1906. Proc. Ent. Soc. Washington, vol. 7, p. 183 (female). Male unknown. **TYPE:** Females (cotypes) in U.S.N.M.\* **TYPE LOCALITY:** Mexico: Tehuantepec, state of Oaxaca. **HABITAT:** Tree holes. **REMARKS:** Larva described by Dyar, Mosquitoes of America, p. 227, 1928.

**lepchana** (Barraud) India

*Finlaya lepchana* Barraud, 1923. Indian Journ. Med. Res., vol. 11, p. 217 (male). Female unknown. **TYPE:** Male (holotype) in British Museum.\* **TYPE LOCALITY:** India: Tindharia, Darjeeling district (Barraud). **HABITAT:** Bamboos. **REMARKS:** Larva not described.

**mackerrasi** Taylor Queensland

*Aedes (Finlaya) mackerrasi* Taylor, 1927. Bull. Ent. Res., vol. 18, p. 68 (male, female). **TYPE:** Male (holotype) in School of Public Health and Tropical Medicine, University of Sydney. **TYPE LOCALITY:** Australia: Berner Creek, Innisfail district, northern Queensland (Taylor). **HABITAT:** Rock pools and in water collected in a log canoe. **REMARKS:** Larva undescribed.

**monocellatus** Marks Queensland

*Aedes (Finlaya) monocellatus* Marks, 1948. Univ. Queensland Pap., Dept. Biol., vol. 2, pt. 8, p. 14 (male, female, larva, pupa). **TYPE:** Female (holotype) in University of Queensland.\* **TYPE LOCALITY:** Australia: Upper Cedar Creek, Queensland (Wassell and Marks). **HABITAT:** Tree holes.

- novalbitarsis** King and Hoogstraal New Guinea  
*Aedes (Finlaya) novalbitarsis* King and Hoogstraal, 1946.  
 Proc. Ent. Soc. Washington, vol. 48, p. 146. New name for  
*albitarsis* Taylor. **HABITAT:** A variety of small natural and  
 artificial water containers.
- Leucomyia* ? *albitarsis* Taylor, 1914 (nec *albitarsis* Ludlow, 1905).  
 Trans. Ent. Soc. London 1914, p. 194 (female). **TYPE:** Fe-  
 male (holotype) in School of Public Health and Tropical Med-  
 icine, University of Sydney. **TYPE LOCALITY:** New Guinea:  
 Lakekainu Gold Field (Giblin).
- occidentalis** (Skuse) Australia; Tasmania  
*Culex occidentalis* Skuse, 1889. Proc. Linn. Soc. New South  
 Wales, vol. 3, p. 1729 (female). Male not specifically de-  
 scribed. **TYPE:** Female (holotype) in Macleay Museum,  
 University of Sydney.\* **TYPE LOCALITY:** Australia: King  
 Georges Sound, western Australia (Masters). **HABITAT:**  
 Ground and rock pools, brackish marshes, fallen palm fronds,  
 concrete well, and holes in fallen logs. **REMARKS:** Larva de-  
 scribed by Lee, Atlas of the mosquito larvae of the Australasian  
 region, p. 60, 1944.
- Culicada cumpstoni* Taylor, 1914. Trans. Ent. Soc. London 1913,  
 p. 692 (female). **TYPE:** Female (holotype) in School of Pub-  
 lic Health and Tropical Medicine, University of Sydney.\*  
**TYPE LOCALITY:** Australia: Melbourne, Victoria (Cumpston).
- Culicada demansis* Strickland, 1911. Entomologist, vol. 44, p.  
 202 (female). **TYPE:** Female (holotype) in British Museum.\*  
**TYPE LOCALITY:** Tasmania (Bancroft).
- Culicada hybrida* Taylor, 1916. Proc. Linn. Soc. New South  
 Wales, vol. 41, p. 568 (female). **TYPE:** Female (holotype)  
 in School of Public Health and Tropical Medicine, University  
 of Sydney.\* **TYPE LOCALITY:** Australia: Milson Island, New  
 South Wales (Cleland).
- Culicelsa queenslandis* Strickland, 1911. Entomologist, vol. 44,  
 p. 179 (female). **TYPE:** Female (holotype) in British  
 Museum.\* **TYPE LOCALITY:** Australia: Queensland (Ban-  
 croft).
- Culicelsa similis* Strickland, 1911. Entomologist, vol. 44, p. 132  
 (female). **TYPE:** Female (holotype) in British Museum.\*  
**TYPE LOCALITY:** Australia: Mount Lofty, southern Australia  
 (Cleland).

- occidentalis** var. **milsoni** (Taylor) New South Wales;  
Queensland  
*Culicada milsoni* Taylor, 1915. Proc. Linn. Soc. New South  
 Wales, vol. 40, p. 179 (male, female). **TYPE:** Female (holo-



type) in School of Public Health and Tropical Medicine, University of Sydney.\* Location of male unknown. TYPE LOCALITY: Australia: Milson Island, New South Wales (Ferguson). HABITAT: Ground and rock pools. Occasionally in brackish marshes. REMARKS: Larva described by Lee, Atlas of the mosquito larvae of the Australasian region, p. 60, 1944.

*Hulecoeteomyia milsoni* Taylor, 1916. Proc. Linn. Soc. New South Wales, vol. 41, p. 566 (female). TYPE: Female (holotype) in School of Public Health and Tropical Medicine, University of Sydney. TYPE LOCALITY: Australia: Milson Island, New South Wales (Cleland).

**palmarum** Edwards Queensland

*Aedes (Finlaya) palmarum* Edwards, 1924. Bull. Ent. Res., vol. 14, p. 382 (female). TYPE: Female (holotype) in British Museum.\* TYPE LOCALITY: Australia: Palm Island, Queensland (Hill). HABITAT: Fallen palm fronds, artificial containers, cup fungi, bamboo, flower spathe, et cetera. REMARKS: Male, larva, and pupa described by Marks, University of Queensland Papers, Dept. Biol., vol. 2, pt. 8, p. 34, 1948.

**papuensis** (Taylor) New Guinea; Solomon Islands

*Leucomyia australiensis*, Theobald var. *papuensis* Taylor, 1914. Trans. Ent. Soc. London 1913, p. 193 (female). TYPE: Female (holotype) in School of Public Health and Tropical Medicine, University of Sydney.\* TYPE LOCALITY: New Guinea: Milne Bay, Papua (Breinl). HABITAT: Tree holes, ground pools, rock pools, and artificial containers.

**purpureus** (Theobald) Queensland; western Australia;  
Northern Territory

*Molpemyia purpurea* Theobald, 1910. A monograph of the Culicidae or mosquitoes, vol. 5, p. 479 (female). Male described by Taylor, Proc. Linn. Soc. New South Wales, vol. 69, p. 122, 1944. TYPE: Female (holotype) in British Museum.\* TYPE LOCALITY: Australia: Stannary Hills, Queensland (Bancroft). HABITAT: Tree holes. REMARKS: Larva (of *hamadryadis*) described by Cooling in original description.

*Aedes (Finlaya) priestleyi hamadryadis* Cooling, 1924. Comm. Australian Dept. Health Serv. Publ. 8, p. 24 (male, female). TYPE: A male collected by Cooling exists in the collection of the School of Public Health and Tropical Medicine, University of Sydney,\* which probably could be considered the type for this name. TYPE LOCALITY: Australia: Derby, western Australia (Cooling).

*Aedes (Finlaya) pecuniosus* Edwards, 1922. Bull. Ent. Res., vol. 13, p. 94 (female). TYPE: Female (holotype) in British Museum.\* TYPE LOCALITY: Australia: Port Darwin, Northern Territory (Strangman).

*Calomyia priestleyi* Taylor, 1914. Trans. Ent. Soc. London, 1913, p. 684 (female). TYPE: Female (holotype) in School of Public Health and Tropical Medicine, University of Sydney.\* TYPE LOCALITY: Australia: Townsville, Queensland (Priestley).

**simlensis** Edwards

Western Himalayas

*Aedes (Finlaya) simlensis* Edwards, 1922. Indian Journ. Med. Res., vol. 10, p. 269 (female). Male unknown. TYPE: Female (holotype) in British Museum.\* TYPE LOCALITY: India: Simla (Christophers). HABITAT: Tree holes. REMARKS: Larva not described.

**stevensoni** (Barraud)

India

*Finlaya stevensoni* Barraud, 1923. Indian Journ. Med. Res., vol. 11, p. 219 (male, female). TYPE: Male, female (cotypes) in British Museum.\* TYPE LOCALITY: India: Bombay, Deccan, Nagargali (Barraud). HABITAT: Bamboos. REMARKS: Larva not described.

**subalbitarsis** King and Hoogstraal

New Guinea

*Aedes (Finlaya) subalbitarsis* King and Hoogstraal, 1946. Proc. Ent. Soc. Washington, vol. 48, p. 144 (male, female, larva). TYPE: Female (holotype) in U.S.N.M.\* TYPE LOCALITY: Dutch New Guinea: Mount Dafonsoero, Cyclops Mountains, Hollandia area (Brewer). HABITAT: Rock pools, rot holes, and artificial containers.

**subsimilis** (Barraud)

India

*Finlaya subsimilis* Barraud, 1927. Indian Journ. Med. Res., vol. 14, p. 552 (male). Female unknown. TYPE: Male (holotype) in British Museum.\* TYPE LOCALITY: India: Sukna, Darjeeling District, 500 feet (Barraud). HABITAT: Bamboo. REMARKS: Larva unknown.

**toxopeusi** Bonne-Wepster

New Guinea

*Aedes (F.) toxopeusi* Bonne-Wepster, 1948. Treubia, vol. 19, p. 315 (male, female). TYPE: Female (holotype) in Institute of Tropical Hygiene, Amsterdam.\* TYPE LOCALITY: New Guinea: Scree Valley, at the foot of Mount Wilhelmina, 3,800 meters (Toxopeus). HABITAT: ? REMARKS: Larva unknown.

- zoösofhus** Dyar and Knab Southwestern United States  
*Aedes zoösofhus* Dyar and Knab, 1918. Insecutor Inscitiae Menstruus, vol. 5, p. 165, 1917 (female). Male not specifically described. TYPE: Female (holotype) in U.S.N.M.\* TYPE LOCALITY: United States: Kerrville, Tex. (Pratt). HABITAT: Tree holes. REMARKS: Larva not specifically described. Male described by Dyar, Mosquitoes of America, p. 222, 1928, under *alleni*.  
*Aedes alleni* Turner, 1924. Insecutor Inscitiae Menstruus, vol. 12, p. 84 (male). TYPE: Males (cotypes) in U.S.N.M.\* TYPE LOCALITY: United States: Mission, Tex. (Turner). REMARKS: Larva was described by Breland, Journ. New York Ent. Soc., vol. 57, p. 93, 1949.

Group H (GENICULATUS-group: PROTOMACLEAYA)

- albolateralis** (Theobald) India; Assam; Yunnan; Malaya; ?Philippines  
*Stegomyia albolateralis* Theobald, 1908. Rec. Indian Mus., vol. 2, p. 289 (females). TYPE: Female (holotype) in collection of Zoological Survey of India, Calcutta. TYPE LOCALITY: Assam: Sylhet (Hall) and Lungleh, Lushai Hills. HABITAT: Tree holes and bamboos.  
**alboniveus** Barraud Eastern Himalayas  
*Aedes (Finlaya) alboniveus* Barraud, 1934. Fauna of British India, Diptera, vol. 5, p. 210 (male, female, larva). TYPE: Male (holotype) in British Museum.\* TYPE LOCALITY: India: Kurseong, Darjeeling district, eastern Himalayas (Barraud). HABITAT: Tree holes and bamboos.

- dissimilis** (Leicester) Yunnan; Malaya; India  
*Stegomyia Dissimilis* Leicester, 1908. The Culicidae of Malaya, p. 91 (male, female). TYPE: Male, female (cotypes) in British Museum.\* TYPE LOCALITY: Malay Peninsula: Ampang and Ulu Klang (Leicester). HABITAT: Tree holes. REMARKS: Larva described by Barraud, Fauna of British India, Diptera, vol. 5, p. 204, 1934.

- dissimilis** var. **karwari** (Barraud) India  
*Finlaya dissimilis* (Leic.) var. *karwari* Barraud, 1942. Indian Journ. Med. Res., vol. 11, p. 865 (female). Male not specifically described. TYPE: Females (cotypes) in British Museum. TYPE LOCALITY: India: Karwar, northern Kanara (Barraud). HABITAT: Tree holes. REMARKS: Larva not specifically described.

**dorseyi Knight**

Palau Islands

*Aedes (Finlaya) dorseyi* Knight, 1946. Journ. Washington Acad. Sci., vol. 36, p. 277 (male, female, larva). TYPE: Male (holotype) in U.S.N.M.\* TYPE LOCALITY: Palau Islands: Garakayo (Dorsey and Dybas). HABITAT: Tree holes and artificial containers.

**eatonii (Edwards)**

Madeira

*Ochlerotatus eatonii* Edwards, 1916. Bull. Ent. Res., vol. 6, p. 358 (male). Female unknown. TYPE: Male (holotype) in British Museum.\* TYPE LOCALITY: Madeira Islands: Monte Funchal, 2,000 feet (Eaton). HABITAT: ? REMARKS: Larva unknown.

**echinus (Edwards)**

Southern Europe; Asia Minor

*Ochlerotatus (Finlaya) echinus* Edwards, 1920. Bull. Ent. Res., vol. 10, p. 133 (female). Male described by Martini, in Lindner: Die Fliegen palaearkt. Reg., vols. 11-12, p. 287, 1931. TYPE: Female (holotype) in British Museum.\* TYPE LOCALITY: Macedonia: Stavros, near Salonica (Waterston). HABITAT: Tree holes. REMARKS: Larva described by Edwards, Bull. Ent. Res., vol. 12, p. 320, 1921.

**geniculatus (Olivier)**

Europe; Asia Minor

*Culex geniculatus* Olivier, 1791. Encycl. Meth. Hist. Nat. Ins., vol. 6, p. 134 (?). TYPE: Nonexistent. TYPE LOCALITY: France: Paris. HABITAT: Tree holes. REMARKS: Male, female, larva described by Marshall, British Mosquitoes, p. 150, 1938.

*Culex equinus* Meigen, 1804. Classification und Beschreibung der Europäischen zweiflügeligen Insecten (Diptera), vol. 1, p. 3. TYPE: Unknown. TYPE LOCALITY: ? REMARKS: We have not seen this reference.

? *Cul. lateralis* Meigen, 1818. Syst. Besch. Eur. Mett., vol. 1, p. 5 (sexes not given). TYPE: Nonexistent. TYPE LOCALITY: ?

*Cul. ornatus* Meigen, 1818. Syst. Besch. Eur. Mett., vol. 1, p. 5 (female). TYPE: Nonexistent. TYPE LOCALITY: ?

*Culex guttatus* Meigen, 1818, Syst. Besch. Eur. Mett., vol. 1, p. 5 (?). TYPE: Unknown. TYPE LOCALITY: ? REMARKS: Edwards, Genera Insectorum, fasc. 194, p. 154, 1932, lists the following original reference for this name: Syst. Besch. Eur. Mett., vol. 6, p. 241, 1830.

*Culex albo-punctatus* Rondani, 1872. Bull. Soc. Ent. Ital., vol. 4, p. 31 (male). TYPE: Unknown. TYPE LOCALITY: ?



**idjenensis** Brug Malaya

*Aedes (Finlaya) niveus* var. *idjenensis* Brug, 1934. Bull. Ent. Res., vol. 25, p. 513 (sex not stated, female by inference). TYPE: One female (cotype) in Instituut voor Tropische Hygiene, Amsterdam. TYPE LOCALITY: Malaya: Eastern part of the Archipelago. HABITAT: ? REMARKS: Larva not known.

**lacteus** Knight Philippines

*Aedes (Finlaya) lacteus* Knight, 1946. Journ. Washington Acad. Sci., vol. 36, p. 275 (male, female, larva). TYPE: Male (holotype) in U.S.N.M.\* TYPE LOCALITY: Philippines: Cape Melville, Balabac Island (Laffon and Johnson). HABITAT: Tree holes.

**laoagensis** Knight Philippines

*Aedes (Finlaya) laoagensis* Knight, 1946. Journ. Washington Acad. Sci., vol. 36, p. 276 (male, female, larva). TYPE: Male (holotype) in U.S.N.M.\* TYPE LOCALITY: Philippines: Laoag, Ilocos Norte Province, Luzon Island (Hoogstraal). HABITAT: Tree holes.

**leucocelaenus** Dyar and Shannon Panama to Argentina

*Aedes leucocelaenus* Dyar and Shannon, 1924. Journ. Washington Acad. Sci., vol. 14, p. 484. New name for *leucomelas* Lutz. HABITAT: Tree holes. REMARKS: Male, larva described by Komp, Proc. Ent. Soc. Washington, vol. 40, p. 260, 1938. *Haemagogus leucomelas* Lutz, 1904 (nec Meigen, 1804). In Bourroul, Mosquitos do Brasil, pp. 44, 66 (female). TYPE: Nonexistent. TYPE LOCALITY: Brazil: States of São Paulo and Rio de Janeiro.

**leucomeres** (Giles) Philippines

*Stegomyia leucomeres* Giles, 1904. Journ. Trop. Med., vol. 7, p. 367 (female). Male unknown. TYPE: Female (holotype) in British Museum.\* TYPE LOCALITY: Philippines: Camp Stotsenberg, Angeles, Pampanga Province, Luzon (Whitmore). HABITAT: ? REMARKS: Larva unknown.

**leucopleurus** Rozeboom Philippines

*Aedes (Finlaya) leucopleurus* Rozeboom, 1946. Journ. Parasit., vol. 32, p. 588 (male, larva). Female unknown. TYPE: Male (holotype) in U.S.N.M.\* TYPE LOCALITY: Philippines: Irahuman River, Palawan (Johnson and Laffon). HABITAT: Tree holes.

**leucotaeniatus** Komp

Panama

*Aedes leucotaeniatus* Komp, 1938. Proc. Ent. Soc. Washington, vol. 40, p. 261 (male, female). TYPE: Male (holotype) in U.S.N.M.\* TYPE LOCALITY: Panama Canal Zone: Comacho (Shropshire). HABITAT: Larva unknown.

**luzonensis** Rozeboom

Philippines

*Aedes (Finlaya) luzonensis* Rozeboom, 1946. Journ. Parasit., vol. 32, p. 589 (male, female, larva). TYPE: Male (holotype) in U.S.N.M.\* TYPE LOCALITY: Philippines: Subic Bay, Luzon Island (MacMillan). HABITAT: Tree holes. Occasionally artificial containers.

**niveoides** Barraud

India; Indo-China; Java; Sumatra

*Aedes (Finlaya) niveoides* Barraud, 1934. Fauna of British India, Diptera, vol. 5, p. 211 (male, ? larva). Female unknown. TYPE: Male (holotype) in British Museum.\* TYPE LOCALITY: India: Nagargali, Bombay, Deccan (Barraud). HABITAT: Tree holes and bamboos.

**niveus** (Ludlow)Sumatra; Bali; Java; Flores; Malacca;  
Borneo; Siam; Philippines; India;  
Ceylon; Andamans

*Stegomyia niveus* Ludlow, 1903. Journ. New York Ent. Soc., vol. 11, p. 139 (female). TYPE: Female (lectotype) in British Museum.\* TYPE LOCALITY: Philippines: Oras, Samar. HABITAT: Tree holes and bamboo stumps. Rock holes?

*Stegomyia pseudonivea* Theobald, 1910. A monograph of the Culicidae or Mosquitoes, vol. 5, p. 176 (male). TYPE: Male (lectotype) in British Museum.\* TYPE LOCALITY: Andaman Islands (Lowis).

**niveus nipponicus** LaCasse and Yamaguti

Japan

*Aedes (Finlaya) niveus nipponicus* LaCasse and Yamaguti, 1948. Mosquito fauna of Japan and Korea, pt. 2, p. 79 (male, female, larva). TYPE: Location unknown. TYPE LOCALITY: Japan: Kyushu and Honshu. HABITAT: Bamboos. Occasionally in stone vases and bowls.

**novoniveus** Barraud

India; Assam; Malaya

*Aedes (Finlaya) novoniveus* Barraud, 1934. Fauna of British India, Diptera, vol. 5, p. 211 (male, female, larva). TYPE: Male (holotype) in British Museum.\* TYPE LOCALITY: India: Mungpoo, Darjeeling District, eastern Himalayas (Barraud). HABITAT: Tree holes and bamboos.

- oreophilus** (Edwards) India  
*Ochlerotatus oreophilus* Edwards, 1916. Bull. Ent. Res., vol. 6, p. 357 (female). TYPE: Female (holotype) in British Museum.\* TYPE LOCALITY: India: Gharia, Murree Hills, western Himalayas (? Howlett). HABITAT: Tree holes. REMARKS: Male, larva described by Barraud, Fauna of British India, Diptera, vol. 5, p. 192, 1934.
- paradisimilis** Rozeboom Philippines  
*Aedes (Finlaya) paradisimilis* Rozeboom, 1946. Journ. Parasit., vol. 32, p. 587 (male, female, larva). TYPE: Male (holotype) in U.S.N.M.\* TYPE LOCALITY: Philippines: Cape Melville, Balabac Island (Johnson and Laffoon). HABITAT: Tree holes, bamboos, and palm stubs.
- peipingensis** Feng China  
*Aedes (F.) peipingensis* Feng, 1938. Chinese Med. Journ., Suppl. 2, p. 520 (male, female). TYPE: Two males, two females (cotypes) in Division of Parasitology, Peiping Union Medical College, Peiping, China. TYPE LOCALITY: China: Peiping (Feng). HABITAT: Tree holes. REMARKS: Larva not described.
- pseudoniveus** (Theobald) Borneo; Malaya; Sumatra  
*Stegomyia pseudonivea* Theobald, 1905. Ann. Hist. Nat. Mus. Hungarici, vol. 3, p. 75 (female). Male unknown. TYPE: Female (holotype) in National Museum of Hungary, Budapest. TYPE LOCALITY: Malaya: Singapore (Biro). HABITAT: One record from latex cup on rubber tree. REMARKS: Larva not described.
- Aedes (Finlaya) subniveus* Edwards, 1922. Indian Journ. Med. Res., vol. 10, p. 269 (female). TYPE: Female (holotype) in British Museum.\* TYPE LOCALITY: Borneo: Kuching (?), Sarawak, (? Hewitt).
- pulchriventer** (Giles) Himalayas; Kashmir; Assam  
*Culex pulchriventer* Giles, 1901. Journ. Bombay Nat. Hist. Soc., vol. 13, p. 608 (sexes not stated). TYPE: Male, female (cotypes) in British Museum.\* TYPE LOCALITY: India: Naini Tal, western Himalayas (Giles). HABITAT: Tree holes. Small pools and pot holes in stream beds. REMARKS: Larva described by Barraud, Fauna of British India, Diptera, vol. 5, p. 200, 1934.
- Howardina himalayana* Giles, 1904. Journ. Trop. Med., vol. 7, p. 384. TYPE: Male (holotype) in British Museum.\* TYPE LOCALITY: India: Naini Tal, western Himalayas.

**saperoi Knight**

Philippines

*Aedes (Finlaya) saperoi* Knight, 1946. Journ. Washington Acad. Sci., vol. 36, p. 271 (male, female, larva). TYPE: Male (holotype) in U.S.N.M.\* TYPE LOCALITY: Philippines: Subic Bay, Luzon Island (Zedeck and Zolik). HABITAT: Tree holes and bamboos.

**suffusus Edwards**

Western Himalayas

*Aedes (Finlaya) suffusus* Edwards, 1922. Indian Journ. Med. Res., vol. 10, p. 270 (female). TYPE: Female (holotype) in British Museum.\* TYPE LOCALITY: India: Simla (Christophers). HABITAT: Tree holes. REMARKS: Male, larva described by Barraud, Fauna of British India, Diptera, vol. 5, p. 194, 1934.

**triseriatus (Say)**

Eastern United States

*C. triseriatus* Say, 1823. Journ. Acad. Nat. Sci. Philadelphia, vol. 3, p. 12 (female). TYPE: Nonexistent. TYPE LOCALITY: United States: Pennsylvania (Say). HABITAT: Tree holes and artificial containers. REMARKS: Male, female, larva described by Carpenter, Middlekauff, and Chamberlain, Mosquitoes of the southern United States, p. 224, 1946.

*Finlaya ? nigra* Ludlow, 1905. Can. Ent., vol. 37, p. 387 (female). TYPE: Female (holotype) in U.S.N.M.\* TYPE LOCALITY: United States: Rock Island Arsenal, Ill. (Craig).

**triseriatus var. hendersoni Cockerell**

Western United States

*Aedes triseriatus* Say var. *hendersoni* Cockerell, 1918. Journ. Econ. Ent., vol. 11, p. 199 (female). TYPE: Female (holotype) in U.S.N.M.\* TYPE LOCALITY: United States: Box Elder Creek, Douglas, Wyo. (Schwabe and Henderson).

**yunnanensis (Gaschen)**

Yunnan

*Finlaya yunnanensis* Gaschen, 1934. Arch. Inst. Past. Indochine, vol. 19, p. 332 (male, female, larva). TYPE: Male, female (? cotypes) in Pasteur Institute, Hanoi, Indo-China. TYPE LOCALITY: China: Si-Chang Mountains, Yunnan (Gaschen). HABITAT: Rock pools in stream beds.

**GROUP UNDETERMINED****halongi Galliard and Ngu**

Indo-China

*Aedes (Finlaya) halongi* Galliard and Ngu, 1947. Ann. Parasit., vol. 22, p. 77 (larva). Male, female unknown. TYPE: Nonexistent. TYPE LOCALITY: Indo-China: Baie d'Along. HABITAT: Not given.



- lauriei** (Carter)<sup>9</sup> Lord Howe Island  
*Ochlerotatus lauriei* Carter, 1920. Proc. Zool. Soc. London, 1920, p. 623 (male, female, pupa, larva). TYPE: Male, female (co-types) in Liverpool School of Tropical Medicine.\* TYPE LOCALITY: Australia: Lord Howe Island (Laurie). HABITAT: Tree hole.  
*Aedes* (*Finlaya*) *lauriei* (Carter) Edwards, 1924. Bull. Ent. Res., vol. 14, p. 383. Emendation of name.

- subauridorsum** Marks Queensland  
*Aedes* (*Finlaya*) *subauridorsum* Marks, 1948. Univ. Queensland Pap., Dept. Biol., vol. 2, No. 8, p. 28 (male, female, pupa, larva). TYPE: Female (holotype) in University of Queensland.\* TYPE LOCALITY: Australia: Mount Mowbullen, Bunya Mountains, Queensland (Wassell). HABITAT: Tree holes and stump holes.

- tonkinensis** Galliard and Ngu Indo-China  
*Aedes* (*Finlaya*) *tonkinensis* Galliard and Ngu, 1947. Ann. Parasit., vol. 22, p. 77 (male, ? female, larva). TYPE: Nonexistent. TYPE LOCALITY: Indo-China: Baie d'Along. HABITAT: Rocky excavation.

- upatensis** Anduze and Hecht Venezuela  
*Aedes* (*Finlaya*) *upatensis* Anduze and Hecht, 1943. Bol. Ent. Venezolana, vol. 2, p. 185 (male). Female unknown. TYPE: Male (holotype) in Institute de Higiene, Caracas, Venezuela. TYPE LOCALITY: South America: Region of Upata, Distrito Piar, Estado Bolívar, Venezuela (Hecht). HABITAT: Rock holes. REMARKS: Larva not described.

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 1928. The mosquitoes of the Americas. Carnegie Institution of Washington, Publ. 387.  
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 1941. Mosquitoes of the Ethiopian region, vol. 3, Culicine adults and pupae. British Museum, London.

<sup>9</sup> Following the completion of this paper, an opportunity occurred for the examination of the types of *lauriei* (male genitalia and larva not seen). Because of the well-defined median scutal line and the vaguer subdorsal line this species would normally be keyed to Group D. However, the median scutal line is broader than is usual in that group and the general adult habitus is different. On the basis of general appearance, it shows marked relationship to the species included in Subgroup VI, *alboannulatus* s. str. of Group F. Also, morphologically it fits into this subgroup on all characters except that the male palpi have only a few apical hairs on III-V. However, it will not key to Subgroup VI because of the unmottled femora.

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#### ADDENDA

The following references came to hand too late to be considered here:

- CHOW, C. Y. Collection of culicine mosquitoes in Tiawan, Formosa, China . . . Quart. Journ. Taiwan Mus., vol. 3, pp. 281-287, 1950 (*sinensis*, new species; Ta-keng, Tai-chung Hsien, Formosa; belongs in Subgroup I of Group H).  
 ———, and Mattingly, P. F. The male genitalia and early stages of *A. (F.) albocinctus* and *A. (F.) albotaeniatus* var. *mikiranus*. Proc. Roy. Ent. Soc. London, ser. b, vol. 20, pp. 80-90, 1951.  
 ROBINSON, G. G. A new species of *Aedes* (*Finlaya*) from northern Rhodesia. Journ. Ent. Soc. South Africa, vol. 13, pp. 80-82, 1950 (*luteostriatus*, new species; Ndola, northern Rhodesia, Africa; belongs in Group C).  
 TSAI, C., and LIEN, J. A new species of *Aedes* (*Finlaya*) found in Taiwan. Journ. Med. Assoc. Formosa, vol. 49, p. 177, 1950. (We have not seen this reference.)  
 VARGAS, L. Los subgeneros de *Aedes*. *Downsiomyia*, n. subgen. . . . Rev. Inst. Salub. Enferm. Trop., vol. 11, pp. 61-69, 1950 (divides *Finlaya* into three subgenera: (*Finlaya*, *Gaulteria*, and *Downsiomyia*); transfers certain species to *Haemagogus*. We believe few of the species were studied in sufficient detail to support changes).









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## A NEW SUBSPECIES OF MARINE ISOPOD FROM TEXAS

By ROBERT J. MENZIES

THROUGH the courtesy of Joel W. Hedgpeth, formerly of the Institute of Marine Science, Port Aransas, Tex., I received 12 specimens of an idotheid isopod that superficially resemble *Erichsonella attenuata* (Harger). A comparison of this material with specimens of *E. attenuata* and *E. filiformis* (Say), lent by Dr. Fenner A. Chace, Jr., curator of the division of marine invertebrates, United States National Museum, reveals the fact that the Texas specimens, in spite of their general appearance, are very closely related to *E. filiformis*. In my opinion, the differences warrant the erection of a new subspecies.

The descriptions given by Harger and Richardson of *E. filiformis* are inaccurate in a few important details, and necessary corrections are made in this paper.

### Genus *ERICHSONELLA* Benedict

Richardson (1905, p. 400) characterized the genus in part with the statement, "The epimera of all the segments of the thorax, including the first, are distinctly separated from the segments." There is no indication of epimeral separation from the first peraeonal (thoracic) somite in the specimens of *E. attenuata* and *E. filiformis* that I have examined, although the epimera of peraeonal somites 2 to 7 are clearly separated from their somites. The male penis is composed of a medially cleft plate (appearing as two separate pieces), and this fact should be added to the generic descriptions of Harger (1880, pp. 354-355) and Richardson (1905, p. 400).

The two subspecies of *E. filiformis* may be distinguished by the following diagnoses:

## ERICHSONELLA FILIFORMIS FILIFORMIS (Say)

FIGURE 103, a

*Stenosoma filiformis* SAY, 1818, p. 424.

*Erichsonella filiformis* (Say) RICHARDSON, 1905, pp. 401-403, figs. 449, 450 (and synonymy).

*Diagnosis*.—Frontal margin below dorsal cephalic elevation with elevated tubercles, one on each side of midline. Supralateral extension of second peraeonal somite extending outward from lateral thoracic margin. Epimeral plates wider than long, those of somites 2 to 4 generally (in some the tips protrude) concealed from dorsal view by the lateral expansion of anterolateral somite margin; those of somites 5 to 7 visible in dorsal view. Midlateral pleotelson extension angulate, extending far beyond pleotelson lateral border. Width (at widest part) of pleotelson exceeding one-half the length.

## ERICHSONELLA FILIFORMIS ISABELENSIS, new subspecies

FIGURES 103, b; 104

*Types*.—Holotype male (U.S.N.M. No. 87482), allotype female (U.S.N.M. No. 87483), and one male and one female paratype (U.S.N.M. No. 89550); two male, two female paratypes, Institute of Marine Science, Port Aransas, Tex.; and four female paratypes, Pacific Marine Station, Dillon Beach, Calif.

*Type locality*.—Ship channel, Gulf of Mexico, at Port Isabel, Tex., Joel W. Hedgpeth collector, March 15, 1947.

*Measurements*.—Holotype, length 11.7 mm., width at widest part (second peraeon somite) 2.0 mm.; allotype, length 10.5 mm., width 2.3 mm.

*Diagnosis*.—Frontal margin below dorsal cephalic elevation smooth, lacking two raised tubercles. Supralateral extension of second peraeonal somite not extending beyond lateral margin. Epimeral plates longer than wide, visible in dorsal view on peraeonal somites 2 to 7. Midlateral pleotelson extension reduced to a mere knob. Width of pleotelson (at widest part) less than one-half the length.

The new subspecies is identical with its parent subspecies, *E. f. filiformis*, in a number of significant respects, differing from it, as is evident from the diagnosis, only in that structures present on *E. f. filiformis* are reduced greatly in size and very slightly in configuration in *E. f. isabelensis*. The reduced structures present an isopod that superficially appears vastly different from its parent subspecies. In fact, specimens of *E. f. isabelensis* have a great resemblance to specimens of *E. attenuata*. However, both *E. f. filiformis* and *E. f. isabelensis* differ from *E. attenuata* in having a widely bifurcating frontal lamina

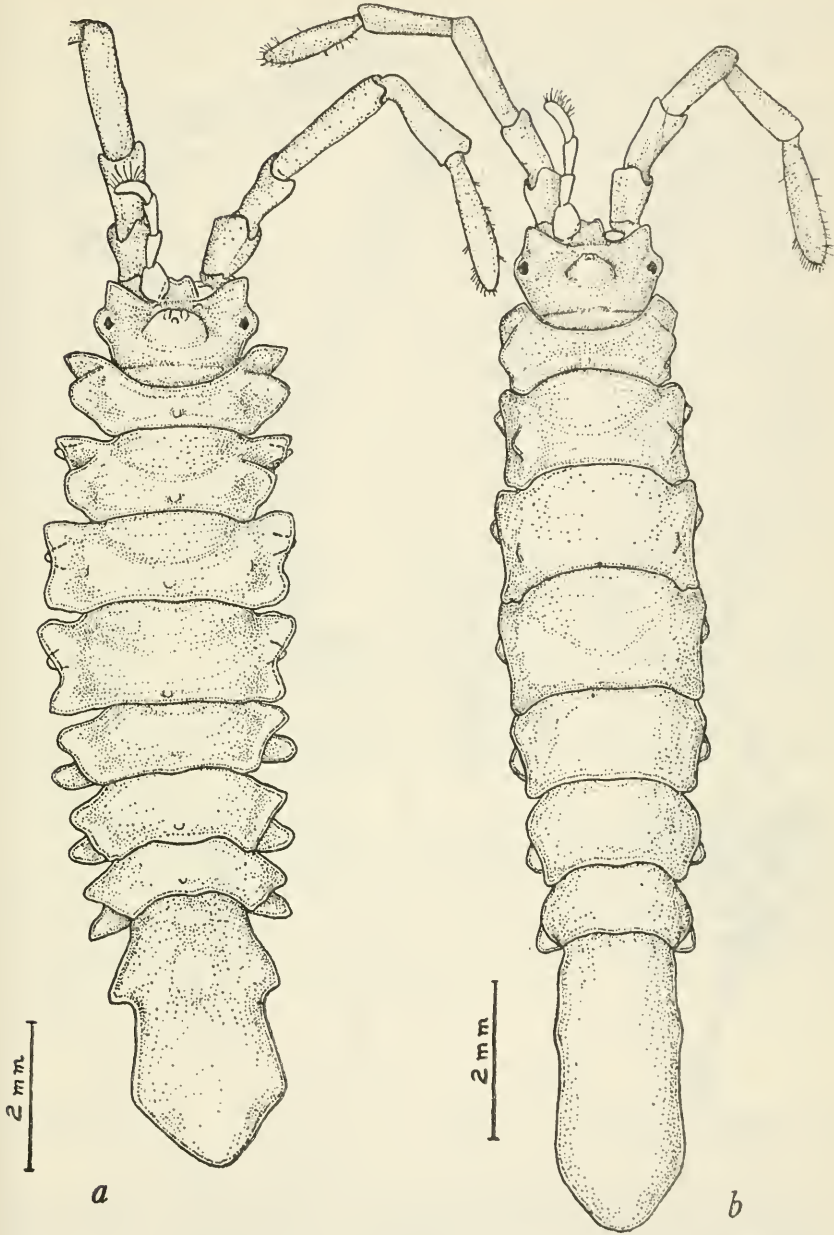


FIGURE 103.—*a*, *Erichsonella filiformis filiformis* (Say) male, dorsal view. *b*, *Erichsonella filiformia isabelensis*, new subspecies, male holotype, dorsal view. Magnification as indicated by scale.

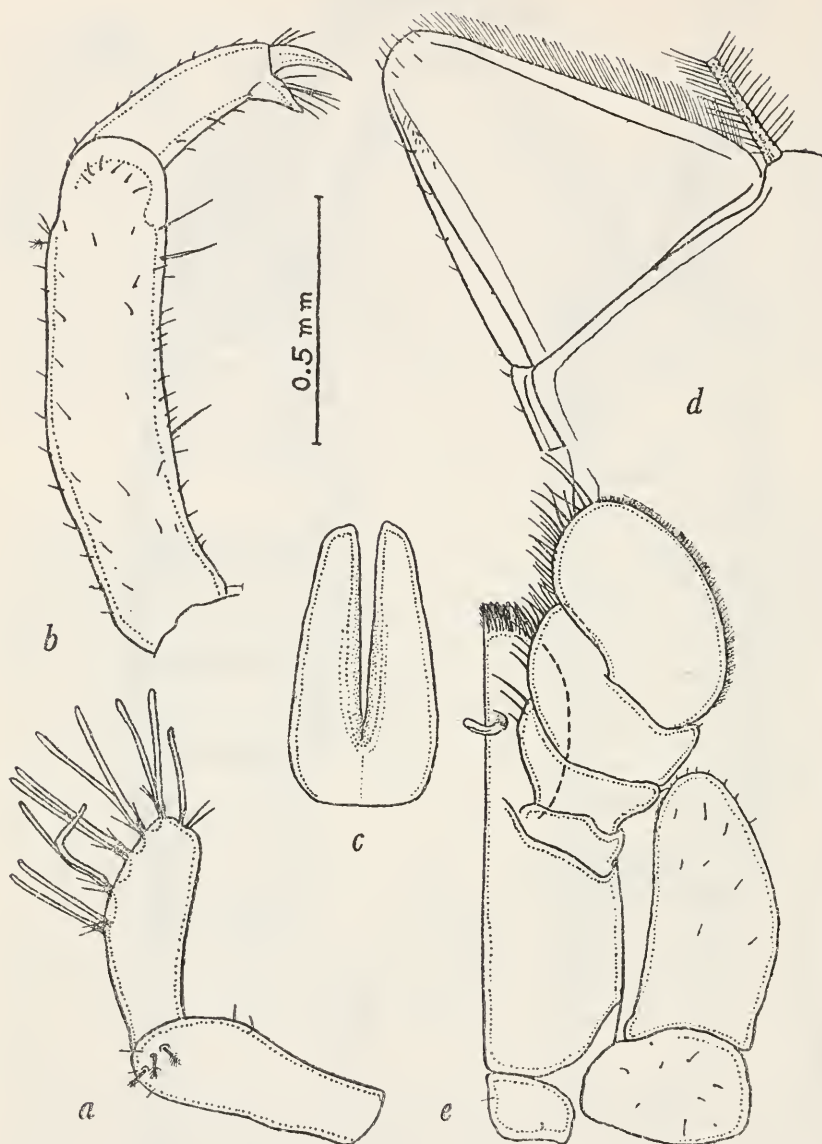


FIGURE 104.—*Erichsonella filiformis isabelensis*, new subspecies: *a*, first antenna, distal joints, allotype; *b*, seventh peraeopod, dactylus and propodus, holotype; *c*, penis, holotype; *d*, left uropod, distal joint, inner surface, holotype; *e*, left maxilliped, holotype. Magnification as indicated by scale.



and in having a greatly elevated mediodorsal cephalic lobe, which is bi- or tri-tuberculate at its apex. In specimens of *E. attenuata* the frontal lamina is narrow and pointed and the cephalon, though slightly swollen dorsally, lacks any elevated apically tuberculate lobe.

Concerning *E. f. filiformis*, Harger and Richardson state: "The angulated epimera are evident from above in front of these [posterior external angles of first two thoracic segments] projections" (Harger 1880, p. 355), and "In the first two segments the lateral parts are produced in very acute processes, one process on either side of each segment. Just anterior to this process is the epimeron, which is also acutely produced, but lies underneath the lateral portion of the segment in a lower plane. The epimeron of the second segment is bilobate, the upper division, in a dorsal view, concealing the lower lobe, which is also very acute" (Richardson 1905, p. 402). These statements are subject to criticism in that they present an erroneous picture of the species. As was said before, the first peraeon somite lacks any clearly separated epimeral plate, that which Richardson and Harger considered an epimeron being merely an anterolateral expansion of the first somite. The epimeral plate of the second somite consists only of what Richardson considered the "lower lobe." It is almost completely concealed from view dorsally, not by a dorsal epimeral lobe, but by an anterolateral expansion of the second somite. Both Richardson and Harger failed to mention the conspicuous raised posterior cephalon area, which is separated from the anterior and larger part of the cephalon by a deep transverse groove. This area is present in both subspecies.

Female specimens of both subspecies appear to have the angulate lateral and supralateral processes more developed than do male specimens. The one male specimen of *E. f. filiformis* that I have examined has the posterolateral expansion of the second somite reduced to a very small lobe, whereas in two ovigerous females this expansion is nearly as large as the anterolateral expansion of that somite. No nonovigerous specimens were examined.

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# STUDIES OF CERTAIN APOGONID FISHES FROM THE INDO-PACIFIC, WITH DESCRIPTIONS OF THREE NEW SPECIES

By ERNEST A. LACHNER

A FAUNAL study of the Apogonidae of the northern Marshall Islands brought to my attention many taxonomic problems involving certain species of the family distributed elsewhere in the Indo-Pacific region. The present paper, a result of this study, includes: 1, A review of the genus *Archamia*; 2, studies of the *Apogon bandanensis* group; and 3, studies of the genus *Paramia*. Three species are described as new.

I wish to thank Donald S. Erdman, formerly of the United States National Museum, for certain field notes; Dr. Ethelwynn Trewavas, of the British Museum (Natural History), and Prof. L. Bertin, Muséum National d'Histoire Naturelle, Paris, for correspondence concerning type specimens; and Dr. J. L. B. Smith, of the Rhodes University College, Grahamstown, South Africa, for kindly providing data and specimens of *Archamia* from Africa. I am indebted to the staff of the Smithsonian photographic laboratory for the photographs.

## METHODS OF COUNTING AND MEASURING

The last ray of both the soft dorsal and the anal fins, divided to the base, is considered as one. All rays of the pectoral fin are counted, including the very small unbranched one at the lower end of the fin base. The count of lateral-line scales includes all scales on the body from the upper edge of the gill opening along the lateral line to the end of the hypural at the base of the caudal fin rays. The scales above the lateral line are counted downward in a posteriorly oblique row

from the origin of the spiny dorsal fin to the lateral-line-scale row and below the lateral line upward in an anteriorly oblique row from the origin of the anal fin to the lateral line. In these two counts, the lateral-line-scale row is not included. The total number of gill rakers recorded includes all rudiments and developed rakers on the first right arch. In some species it is important to tabulate separately the number of rudiments from the developed rakers. In these cases, the number of rudiments is recorded preceding the number of developed rakers on the upper limb and separated by a comma. On the lower limb the rudiment count follows the developed-raker count. The raker at the angle of the arch is preceded and followed by a plus sign and thus distinguished from those on the limbs (e. g., 2,5+1+16,3 or 7+1+19). All measurements of the length of a fish refer to the standard length.

## A REVIEW OF THE GENUS ARCHAMIA

### Genus ARCHAMIA Gill

*Archamia* GILL, 1864, p. 81. (Orthotype, *Apogon bleekeri* Günther, 1859 = *Apogon fucatus* Cantor, 1850, or *Apogon lineolatus* Cuvier and Valenciennes, 1828.)

A useful key to the genera of the apogonid fishes was presented by Schultz (1940, pp. 404-408). The significant characters referred to by Schultz for *Archamia*, the number of anal fin rays and dentition of the jaws, show considerable overlap with certain groups of species of *Apogon*. My recent studies indicate that *Archamia* is most closely related to the genus *Apogon*. In view of the many species of *Apogon* and the lack of a comprehensive understanding of this genus, it is probably best to retain *Archamia* until a thorough study of *Apogon* has been completed. Certainly there are greater differences between various groups of species of the genus *Apogon* than exist between species of these two genera. I hesitate to make generic changes without a more comprehensive knowledge of the species of this family than I have at present. *Archamia* may be distinguished from *Apogon* by a combination of characters: In *Archamia*, anal rays II, 12 to 18 (anal fin rays II, 12 to 13 in *Apogon gracilis* Bleeker and *Apogon mentalis* Evermann and Seale); spines in spinous dorsal VI; vomer and palatines with villiform teeth; anterior margin of preopercle not serrated; posterior margin of preopercle serrated; total number of gill rakers 19 to 24; lateral line complete; caudal fin emarginate to moderately forked; villiform teeth on vomer and palatines in a single row; villiform teeth of upper jaw in a narrow band, those of lower jaw in a narrow band anteriorly, becoming a single row posteriorly (this type of dentition is also characteristic of the *Apogon bandanensis* group).

The literature concerning the species of *Archamia* is extremely confusing. At least 11 specific names can probably be referred to this genus, 5 of which are now placed in synonymy. Most of these species were described with little detail, the critical characters were not analyzed, and the diagnoses were so incomplete as to render the accounts indistinguishable and useless. Six distinct species are herein recognized. The genus is found in the tropical and subtropical marine waters of the Indo-Pacific, from the east African coast to islands of Oceania, but is not yet known from the Hawaiian Islands.

No significant differences were found in an analysis of the following characters for all the species: Lateral line scales ranging from 22 to 26; scales above the lateral line 2; scales below the lateral line 6 or 7; dorsal fin rays VI–I, 9; pectoral rays 13 to 15. The key summarizes the salient differences among the species.

#### KEY TO THE SPECIES OF ARCHAMIA

- 1a. Body with narrow horizontal stripes in preserved specimens, situated along the middorsal line, dorsolaterally and on midside of body; soft anal rays range from 12 to 13; round, blackish spot at base of caudal fin about equal to size of pupil ----- *A. buruënsis* (Bleeker)
- 1b. Body without horizontal stripes in preserved specimens; soft anal rays range from 13 to 18; spot, at base of caudal, variable in size and sometimes obsolete.
  - 2a. A broad, brownish-black, slightly oblique band encircling body and extending from soft dorsal to belly, its horizontal width about 1.5 to 2.5 in head length; no dark humeral spot at junction of gill opening and body, and no dark spot on body just posterior to opercular flap; soft anal rays range from 14 to 16; brownish-black caudal spot smaller than diameter of pupil ----- *A. zosterophora* (Bleeker)
  - 2b. No band present; a black humeral spot or dusky spot on body just posterior to operculum; soft anal fin rays range from 16 to 18.
    - 3a. A dusky, diffuse spot or blotch more or less irregular, and deeper than wide, on body just posterior to opercular flap and below lateral line; a diffuse, dark-brown to blackish circular spot at base of caudal fin, its diameter about equal to diameter of eye.
      - A. dispilus*, new species
    - 3b. An intense, circular to squarish, black humeral spot at junction of gill opening and body, the lateral line passing through middle of spot; an intense, sharp, round, black spot at midbase of caudal fin, its diameter slightly larger than pupil and twice in diameter of eye.
      - A. biguttata*, new name
  - 2c. No band on body; no dark humeral spot or dusky spot on body just posterior to operculum; brownish-black spot at base of caudal fin larger than diameter of pupil, but usually smaller than diameter of eye, sometimes diffuse to obsolete.
    - 4a. Number of soft anal rays averages higher than 16, ranges from 15 to 18; total number of gill rakers averages fewer than 21; total number of gill rakers minus number of soft anal rays equals 5 or fewer; spot at base of caudal fin dusky, diffuse and large in adults, its vertical diameter about 1.5 in least depth of caudal peduncle.
      - A. fucata* (Cantor)

- 4b. Number of soft anal rays averages fewer than 14, range from 13 to 15; total number of gill rakers averages about 22; total number of gill rakers minus number of soft anal rays equals 7 or more; spot at base of caudal fin usually intensely developed, blackish and smaller, about 2.0 to 2.5 in least depth of caudal peduncle, proportionately smaller in young.

A. *lineolata* (Cuvier and Valenciennes)

ARCHAMIA BURUËNSIS (Bleeker)

*Apogon buruënsis* BLEEKER, 1856a, p. 394 (type locality, Kajeli, Bouro).

*Amia buroënsis* BLEEKER, 1873-76, vol. 7, p. 102; 1876-77, vol. 8, pl. (75) 353, fig. 2.

*Specimens studied*.—U.S.N.M. No. 112111, 43 specimens, 25 to 53 mm., May 20, 1908, below mouth of Min River, Cotabato, Mindanao, Philippine Islands; U.S.N.M. No. 112112, 1 specimen, 62 mm., August 6, 1906, below mouth of Monucan River, Mindanao; U.S.N.M. No. 112113, 1 specimen, 43 mm., March 17, 1909, Port Dupon, Leyte Island, Philippine Islands; U.S.N.M. No. 112114, 3 specimens, 53 to 65 mm., April 2, 1909, Mantaquin Bay, Palawan Island, Philippine Islands; U.S.N.M. No. 112115, 1 specimen, 14 mm., August 8, 1908, China Sea, (lat. 20°31' N., long. 115°49' E.); U.S.N.M. No. 112116, 12 specimens, 49 to 63 mm., December 10, 1909, Tifu Bay, Bouru Island, Moluccas Islands; (all specimens collected by the *Albatross* expedition).

*Description*.—This species is comparatively more elongate and less deep than all other members of the genus. This is particularly evident in the smaller specimens. The following measurements were taken from 7 specimens ranging from 36 to 63 mm. in length: Body depth 2.5 to 3.1; head length 2.3 to 2.5; head depth 3.4 to 4.0; length of caudal peduncle 4.0 to 4.2, all in standard length. Eye 3.2 to 3.8; upper jaw 2.1 to 2.2; depth of caudal peduncle 2.5 to 3.0; snout 4.8 to 4.9, all in length of head.

The total number of gill rakers ranges in 11 specimens from 21 to 23 (table 3).

*Color in alcohol*.—Head and body brownish; scattered brownish-black, pepperlike spots on snout, top and sides of head, and on chin; three narrow blackish horizontal stripes on head and body; a middorsal stripe extends from occiput to origin of spinous dorsal fin, appearing faintly at base of spinous and soft dorsal fin and ending in a spot at end of last ray of soft dorsal fin; a dorsolateral stripe begins on each side of snout, passing just above eye and through lateral line on anterior portion of body, and then to dorsolateral portion of caudal peduncle, where it gradually fades and becomes obscure; the midbody stripe begins at tip of snout, passes through middle of eye and extends along midbody area to spot at midbase of caudal fin; a faint stripe begins at origin of anal, passing on each side of anal fin, and extends to about the procurrent rays of caudal fin on the lowermost portion of



caudal peduncle, where stripes on each side nearly join; an intense brownish-black, circular to oval spot present at midbase of caudal fin, its horizontal diameter about equal to diameter of pupil.

*Range*.—Philippine and eastern East Indies Islands, China Sea off northwest Luzon and New Guinea (Macleay, 1884, p. 252).

*Remarks*.—The only species of *Archamia* having horizontal stripes on the body, it is further characterized by having the lowest anal count and a more slender body, resembling *Apogon gracilis* and *Apogon mentalis* in the latter two characters. The *Apogon gracilis* and *A. mentalis* group are distinguished from *buruënsis* in having a higher number of gill rakers, 25 to 28, and having both margins of preopercle smooth.

No specimens contained buccal ova although the ova were well developed in female specimens about 60 mm. in length.

#### ARCHAMIA ZOSTEROPHORA (Bleeker)

*Apogon zosterophora* BLEEKER, 1856b, p. 36 (type locality, Manado, Celebes).

*Amia zosterophora* BLEEKER, 1873-76, p. 103, Perc. 35, tab. 313, fig. 2.

*Specimens studied*.—U.S.N.M. No. 123386, 2 specimens, 29 and 49 mm., December 1944, Tanamera Bay, New Guinea (Lt. Otis Barton); U.S.N.M. uncataloged collections, several hundred specimens ranging in length from 28 to 68 mm., collected in 1908 and 1909 in the East Indies and Philippine Islands (*Albatross* expedition). These collections were reported on by Fowler and Bean (1930, pp. 117-119).

*Description*.—In addition to the characters listed in the key, *zosterophora* has a slightly lower number of gill rakers (range from 19 to 22, table 3) than the other species of the genus. The body is more deeply proportioned than that of *buruënsis*, but in this respect it is very similar to all the other species.

*Color in alcohol*.—Head and body tan; cheeks and opercles iridescent silvery tan; fins transparent except some dusky in most specimens on lower half of soft dorsal fin. Three color marks, each varying in intensity, make this species extremely conspicuous. These are (1) a wide brownish bar extending from tip of snout to anterior margin of middle portion of eye; (2) a broad, brownish-black, nearly vertical band (slightly oblique and sloping dorsoventrally toward the head), its horizontal width at the midbody area about  $1\frac{1}{2}$  to  $2\frac{1}{2}$  in length of head, and almost completely faded in some specimens; and (3) an intense, small, round brownish-black spot at midbase of caudal fin. Fowler and Bean (1930, pp. 116-117) present descriptions of colors in life and a good illustration (Fowler, 1918, p. 29).

*Range*.—Known from the East Indies Islands (Bleeker, 1856b, p. 36; Weber, 1913, p. 236), Philippine Islands (Fowler, 1918, p. 28; Fowler and Bean 1930, p. 117), New Guinea (Macleay, 1883, p. 235), western

Caroline Islands (Herre, 1935, p. 164), and the Solomon Islands (Herre, 1936, p. 137).

*Remarks.*—A single male specimen was found with ova in the buccal cavity.

ARCHAMIA DISPILUS, new species

PLATE 17, c

*Archamia macropterooides* EVERMANN and SEALE, 1907, p. 74.

*Amia bleekeri* FOWLER and BEAN, 1930, p. 110 (in part).

*Holotype.*—U.S.N.M. No. 112041, a specimen, 58 mm. in standard length, collected January 29, 1910, in Soo Wan Bay, Formosa, by the *Albatross* expedition.

*Paratypes.*—U.S.N.M. No. 112077, 5 specimens, 53 to 68 mm., taken with the holotype and bearing same data; U.S.N.M. No. 112078, 1 specimen, 57 mm., January 25, 1910, Kwa Siang Bay, Formosa; U.S.N.M. No. 112080, 1 specimen, 63 mm., June 13, 1909, Butauanan Island, Philippine Islands; U.S.N.M. No. 112079, 1 specimen, 57 mm., May 9, 1908, Generale Island, off northeast coast of Mindanao, Philippine Islands (all collected by the *Albatross* expedition); U.S.N.M. No. 56147, 4 specimens, 36.5 to 58 mm., 1903, Bacon, Sorsogon Province, Luzon Island, Philippine Island (C. J. Pierson); U.S.N.M. No. 126368, 3 specimens, 54 to 63 mm., bearing same data as above.

*Description.*—This description is based on the holotype and paratypes listed above. The counts are recorded for the holotype, followed in parentheses by the average and range of counts taken from 15 paratypes. Where counts for the paratypes are identical with those of the holotype, but one number is given.

Dorsal rays VI-I,9; anal rays II,17 (II,16.5: II,16 to II,18); pectoral rays, 14 (14.1: 14 to 15); pelvic rays I,5; branched caudal rays 8,7; lateral line scale rows 26 (24.8: 24 to 26); scale rows above lateral line 2; scale rows below lateral line 6 (6.5: 6 to 7); gill rakers 2,4+1+15,0 (range 1 or 2 rudiments, 3 or 4 developed rakers +1+14 to 16 developed rakers, 0 or 1 rudiments; total count averages 21.1).

Measurements, expressed in thousandths of the standard length, are given for the holotype and 4 paratypes in table 1, and compared with *A. biguttata*.

First spine of spiny dorsal about two-fifths length of second; second spine longest, about  $1\frac{1}{4}$  times longer than diameter of eye, but only slightly longer than third spine; second anal spine slightly longer than diameter of eye, first anal spine short, about one-fifth length of second spine; posterior margin of preopercle finely serrated, especially lower edge, anterior margin smooth; ctenoid scales with 8 to 12 radii; upper jaw reaches vertical drawn through middle of eye; lateral line complete; longest gill raker about twice longer than longest filament, and twice in diameter of eye.

Teeth in lower jaw short, conical, directed inward and arranged in two more or less regular rows anteriorly and one row posteriorly; teeth of upper jaw short and conical, anteriorly, and arranged in one to two irregular rows followed by a wide band of villiform teeth posteriorly.

Body deep and compressed (table 1); snout rounded; jaws oblique; pectoral fins pointed; contour of soft dorsal fin rounded; anal fin apparently falcate; caudal fin emarginate; depressed spiny dorsal just touches anterior base of soft dorsal; pelvic fins reach beyond vent but not to origin of anal fin.

TABLE 1.—Measurements in thousandths of the standard length of two species of *Archamia*

Character	<i>dispilus</i>		<i>biguttata</i> <sup>1</sup>
	Holotype	4 paratypes <sup>2</sup>	5 specimens
Standard length, mm.....	58	62 (57-68)	60 (56-63)
Greatest body depth.....	413	<sup>3</sup> 413 (403-424)	439 (425-455)
Body width.....	143	140 (121-152)	141 (131-147)
Head length.....	381	377 (371-386)	386 (375-394)
Head depth at occiput.....	349	336 (309-356)	376 (361-393)
Length of caudal peduncle.....	206	193 (170-207)	204 (189-224)
Least depth of caudal peduncle.....	159	153 (141-162)	153 (143-164)
Length of longest pectoral ray.....	302	287 (279-301)	306 (299-312)
Length of second spine of spinous dorsal.....	182	157 (140-182)	154 (143-168)
Diameter of eye.....	127	127 (114-135)	133 (127-134)
Length of upper jaw.....	190	186 (175-191)	184 (175-189)
Length of snout.....	80	81 (73-93)	83 (79-89)
Least width of bony interorbital.....	95	91 (88-95)	97 (95-100)
Tip of snout to origin of spinous dorsal fin.....	412	413 (403-424)	426 (417-437)
Tip of snout to origin of anal fin.....	635	610 (592-633)	606 (585-617)
Tip of snout to insertion of pectoral fins.....	381	373 (354-391)	391 (377-401)
Tip of snout to insertion of pelvic fins.....	381	383 (369-406)	406 (394-418)
Tip of snout to anal opening.....	538	535 (516-543)	540 (532-552)

<sup>1</sup> From the Philippine Islands.

<sup>2</sup> From Formosa and the Philippine Islands.

<sup>3</sup> The average value is followed by the range of variation in parentheses.

*Color in alcohol*.—Body and head brownish with numerous fine dark-brown pepperlike spots, especially abundant on chin, snout, cheeks, opercles, and midside of body; a large, diffuse, circular dark-brown to blackish spot at base of caudal fin, its diameter almost equal to depth of caudal peduncle and about equal to diameter of eye; an irregular dark-brown spot or blotch just below lateral line and posterior to opercular flap; basal portion of caudal fin with fine, scattered, brown dots; remainder of fins transparent.

Named *dispilus* in reference to the two dark spots on the body.

*Range*.—Formosa and the Philippine Islands.

## ARCHAMIA BIGUTTATA, new name

## PLATE 17, d

*Amia macropterus* BLEEKER, 1874, pp. 72-74; 1873-76, p. 103; 1876-77, Perc. 68, tab. 346, fig. 2, preoccupied by *Apogon macropterus* (non Bleeker) Cuvier and Valenciennes, 1828, p. 160=*Apogon lineolatus* Cuvier and Valenciennes, 1828, p. 160.

*Amia bleekeri* FOWLER and BEAN, 1930, p. 110 (in part).

*Specimens studied.*—U.S.N.M. No. 56156, 17 specimens, 51 to 62 mm., Bacon Island, Philippine Islands (received from the Philippine Commission); U.S.N.M. No. 112137, 2 specimens, November 9, 1909, Talisse Island, Celebes; U.S.N.M. No. 112138, 1 specimen, November 10, 1909, Limbe Strait, Celebes; U.S.N.M. No. 112139, 1 specimen, November 17, 1909, Gulf of Tomini, Benang Unang Island, Celebes; U.S.N.M. No. 112140, 1 specimen, December 21, 1909, Tana Keke, Celebes; U.S.N.M. No. 112141, 2 specimens, December 29, 1909, Libani Bay, Celebes; U.S.N.M. No. 112142, 2 specimens, November 28, 1909, Makyan Island, Moluccas Islands; U.S.N.M. No. 112143, 3 specimens, November 29, 1909, Makyan Island, Moluccas Islands; U.S.N.M. No. 112144, 4 specimens, December 12, 1909, Tomahu Island, Moluccas Islands; U.S.N.M. No. 112145, 2 specimens, December 10, 1909, Boero Island, Tifu Bay, Moluccas Islands; U.S.N.M. No. 112146, 5 specimens, December 9, 1909, Boero Island, Moluccas Islands; U.S.N.M. No. 112147, 1 specimen, November 25, 1909, Sea of Ternate, Tidore Island, Moluccas Islands; U.S.N.M. No. 112148, 4 specimens, June 13, 1909, Butaanan Island, Luzon, Philippine Islands; U.S.N.M. No. 112149, 1 specimen, June 22, 1909, Rapurapu Island, Luzon, Philippine Islands; U.S.N.M. No. 112150, 1 specimen, May 9, 1909, Dasol Bay, Luzon, Philippine Islands; U.S.N.M. No. 112151, 1 specimen, August 3, 1909, Mahinog, Camiguin Island, Philippine Islands; U.S.N.M. No. 112152, 1 specimen, July 27, 1909, Casagoran, Homonhon Island, Philippine Islands; U.S.N.M. No. 112153, 1 specimen, April 9, 1909, Bisucay Island, Luzon, Philippine Islands; U.S.N.M. No. 112154, 1 specimen, June 7, 1908, Batangas Market, Luzon, Philippine Islands; U.S.N.M. No. 112155, 1 specimen, April 5, 1909, Puerto Princesa, Palawan, Philippine Islands; U.S.N.M. No. 112156, 3 specimens, December 21, 1908, Bolalo Bay, Palawan, Philippine Islands (specimens in U. S. National Museum, Nos. 112137 to 112156, range from 31 to 66 mm.); U.S.N.M. No. 112157, 5 specimens, 43 to 60 mm., January 3, 1909, Port Ciego, Balabac, Philippine Islands; U.S.N.M. No. 112158, 25 specimens, 47 to 57 mm., July 29, 1909, San Roque, Leyte, Philippine Islands; U.S.N.M. No. 112159, 34 specimens, 32 to 46 mm., June 17, 1909, Maagnas, Lagonoy Gulf, Luzon, Philippine Islands; U.S.N.M. No. 112160, 40 specimens, 34 to 40 mm., May 10, 1909, Bolinao Bay, Luzon, Philippine Islands (U.S.N.M. Nos. 112137 to 112160 were col-



lected by the *Albatross* expedition); U.S.N.M. No. 111964, 1 specimen, 37 mm., June 4, 1902, Apia, Samoa (Jordan and Kellog).

*Description.*—The head and body proportions and the number of fin rays and gill rakers are nearly identical to those of *A. dispilus* (tables 2 and 3).

*Color in alcohol.*—Head and body tan to brown with some light-bluish silvery iridescence on cheek, opercle, and side of body; some fine, scattered pepperlike brown spots on sides of head and a few on the body; a broad, dark-brown, vertical band, its greatest width slightly exceeding diameter of pupil, extends from lower margin of eye to basal margin of anterior preopercle; the most significant character present in this species and absent in all other members of the genus is the presence of a blackish humeral spot at junction of gill opening and body, circular to squarish in shape, its greatest diameter equal to or only slightly larger than diameter of pupil; humeral spot almost always intensely developed (faded but not obscure in about one percent of specimens listed above); a blackish, intense, circular spot at midbase of caudal fin, sometimes faded or completely obscure, its diameter slightly larger than pupil and about twice in diameter of eye.

The name *biguttata* refers to the two dark spots, the humeral spot and the one at the midbase of the caudal fin (pl. 17, *d*).

*Range.*—East Indies, Philippine and Samoan Islands.

*Remarks.*—Although Bleeker's account (1874, pp. 72–74) of *Amia macropterus* contains more than one species by the inclusion of such data as the anal fin rays ranging from II, 14 to II, 18 and his statement on the variability of the humeral spot, it is distinctly understood which species he examined from his illustration (1876–77, tab. 346, Perc. tab. 68, fig. 2). His name is unfortunately preoccupied (see synonymy of *Archamia lineolata*, p. 591). The low anal-ray count, II, 13, listed by Cuvier and Valenciennes (1828, p. 160) for *Apogon macropterus*, and the absence of mention of a spot at the junction of the gill opening and body, certainly define Bleeker's *macropterus* as a different species. Examination of several collections totaling more than a hundred specimens, from small juveniles to adults, confirmed the constant presence of the well-developed humeral spot on the body at the junction of the gill opening.

The single specimen from Apia, Samoa (U. S. N. M. No. 111964) was taken in the same collection with *Archamia fucata* and *A. lineolata*, but it was apparently overlooked by Jordan and Seale (1906, p. 252). Recent intensive collecting by Schultz and others in the Marshall Islands, as well as in the Phoenix and Samoan Islands (Schultz, 1943), failed to reveal a single specimen, indicating that it is probably not common or does not occur in this area of the Pacific.

## ARCHAMIA FUCATA (Cantor)

## PLATE 17, b

*Apogon fucatus* CANTOR, 1850, p. 986 (anal fin rays II, 16; type locality, Sea of Pinang).

*Apogon macropterooides* BLEEKER, 1852, p. 724 (anal fin rays II, 16 or 17; Lepar Island).

*Apogon bleekeri* GÜNTHER, 1859, p. 245 (anal fin rays II, 14 to 17; Amboyna) = *Apogon lineolatus* Cuvier and Valenciennes (?), 1828, vol. 2, p. 160.

*Apogon notata* DAY, 1867, p. 936 (anal fin rays II, 16; Madras).

*Archamia kagoshimana* DÖDERLEIN (MS.), in Steindachner and Döderlein, 1884, p. 3 (anal fin rays II, 16; Kiusiu Island).—JORDAN and SNYDER, 1901, p. 907.

*Archamia lineolata* JORDAN and SEALE, 1906, p. 252.—FOWLER and BEAN, 1930, pp. 113–117 (in part).—SCHULTZ, 1940, p. 412; 1943, p. 94.

*Specimens studied*.—U. S. N. M. Nos. 149404 to 149431 and 149433 to 149452, totaling 685 specimens, 18 to 27 mm., 1908 and 1909, East Indies and Philippine Islands (*Albatross* expedition); U. S. N. M. No. 149432, 2 specimens, 52 and 72 mm., January 29, 1910, Hokuko Soo Wan, Formosa (*Albatross* expedition); U. S. N. M. Nos. 52203, 111967, and 126601, totaling 67 specimens, 18 to 56 mm., 1902, Apia, Samoa (Jordan and Kellogg); U. S. N. M. Nos. 142460, 142461 and 142462, totaling 79 specimens, 33 to 57 mm., 1946, Rongelap and Bikini Atolls, northern Marshall Islands (Herald, Brock, and Schultz).

*Description*.—See discussion that follows description of *lineolata* and data in tables 2 and 3 (pp. 591, 592).

*Color in alcohol*.—Body and head light tan with fine brown flecks on cheeks, opercles, and sides of body; tip of jaws with some black pigment flecks; small brown spots forming a faint streak extending from the tip of the upper jaw to beneath eye; a large, circular, blackish-brown blotch at base of caudal fin, sometimes diffuse to obsolete, variable in size (smaller in younger specimens), usually a little less in depth than least depth of caudal peduncle but in some small specimens about one-half depth of caudal peduncle; spinous dorsal fin tipped in blackish; remainder of fins transparent; traces of about twenty brown and silvery, narrow, vertical bars in some specimens, usually obsolete.

*Range*.—Represented in our collections from the East Indies, Philippine, Samoan, and Marshall Islands.

*Remarks*.—There has been no attempt to compile completely the synonymy of this or the other species included in this paper, for it is considered quite hopeless to do so without having the specimens reported upon in the various literature, critical accounts of the species, or good illustrations. This also applies to the "range" given for each species.

## ARCHAMIA LINEOLATA (Cuvier and Valenciennes)

## PLATE 17, a

*Apogon lineolatus* CUVIER and VALENCIENNES, 1828, p. 160 (anal fin rays, II, 14; type locality, Red Sea).

*Apogon macropterus* CUVIER and VALENCIENNES, 1828, p. 160 (anal fin rays II, 13; Java).

*Apogon zeylonicus* CUVIER and VALENCIENNES, 1829, p. 491 (anal fin rays II, 14; Ceylon).

*Apogon argenteus* VALENCIENNES, 1832, p. 60 (anal fin rays II, 14; Vanicolo).

*Archamia bleekeri* GÜNTHER, 1859, p. 245 (anal fin rays II, 14 to 17; Amboyna)  
=*Apogon fucatus* Cantor (?), 1850, p. 986.

*Specimens studied*.—U.S.N.M. No. 57944, 5 specimens, 18 to 21 mm., Zamboanga, Mindanao, Philippine Islands (E. A. Mearns); U.S.N.M. Nos. 112117–112128, 23 specimens, 41 to 64 mm., 1908–09, East Indies and Philippine Islands (*Albatross* expeditions); U.S.N.M. No. 126601, 7 specimens, 40 to 53 mm., 1902, Apia, Samoa (Jordan and Kellogg).

*Color in alcohol*.—General coloration about the same as in *fucata*, except that the circular black spot at the midbase of the caudal fin is smaller and more intensely developed. Its greatest diameter measures about 2.0 to 2.5 in the least depth of the caudal peduncle. This spot is proportionately smaller in younger specimens, measuring about 2.5 to 3.5 in the least depth of the caudal peduncle.

*Range*.—Red Sea, East Africa to East Indies, Philippine Islands, Samoa, and probably other groups of islands of Oceania.

TABLE 2.—Frequency distribution of the number of soft anal fin rays for species of *Archamia*

Species and locality	Soft anal rays						
	12	13	14	15	16	17	18
<i>biguttata</i> , Philippine Islands.....					14	8	—
<i>dispilus</i> , Formosa and Philippine Islands.....					8	3	2
<i>buruënsis</i> , Philippine Islands.....	9	7					—
<i>lineolata</i> , East Indies and Philippine Islands.....		7	31	3			—
Samoa.....		1	4	3			—
<i>fucata</i> , East Indies and Philippine Islands.....				1	15	6	1
Formosa.....						1	—
Northern Marshall Islands.....					7	6	—
Samoa.....					7	12	2
<i>zosterophora</i> , Philippine Islands.....			6	7	3		—

*Remarks*.—For some years *Archamia fucata* has been considered synonymous with *Archamia lineolata*. Bleeker's account (1874, p. 72) and figure (1876–77, tab. 346, perc. tab. 68, fig. 2), as well as that of Weber and de Beaufort (1929, p. 347), confound even a third species

(*A. biguttata*). *Archamia fucata* and *A. lineolata* are remarkably similar in body form, scutellation, pigmentation, and fin-ray counts, with the exception of the anal fin. A small difference was found also in the gill-raker counts. A summary of the distribution of the number of soft anal fin rays and gill rakers for the species of *Archamia* are given in tables 2 and 3. About 6 percent of the anal fin rays between *fucata* and *lineolata* show an overlap, *fucata* averaging about  $21\frac{1}{2}$  rays more. *A. lineolata* averaged about one more developed raker on the upper arch and about one-half raker more on the lower arch. When the number of gill rakers and soft anal fin rays was considered for each of these species, all specimens studied were separated.

TABLE 3.—The number of gill rakers on the first gill arch for species of *Archamia*<sup>1</sup>

Species	Upper right limb <sup>2</sup>					Lower right limb <sup>3</sup>				Total					
	1,3	2,3	3,3	1,4	2,4	13	14	15	16	19	20	21	22	23	24
<i>biguttata</i> .....		4	5	3	2		1	7	6		2	4	4	4	
<i>dispilus</i> <sup>4</sup> .....		9		2	2		3	7	3		3	6	3	1	
<i>buruensis</i> .....					11		2	6	3			2	6	3	
<i>lineolata</i> .....		1	2	2	12		1	11	5			6	15	6	1
<i>fucata</i> .....		16					5	11			6	13			
Formosa.....			1					1					1		
Northern Marshall Islands.....		10					3	7			3	7			
Samoa.....		4	1				3	2			3	1	1		
<i>zosterophora</i> .....	2	4	6	1	1	2	9	3		3	3	6	2		

<sup>1</sup> All collections from the Philippine Islands unless indicated otherwise.

<sup>2</sup> The rudiment count precedes the developed-raker count and is separated from it by a comma.

<sup>3</sup> A single tiny rudiment was sometimes present and was included in the count. The raker at the angle was included in the total count only.

<sup>4</sup> From Formosa and Philippine Islands.

A character index formed by subtracting for each individual specimen the number of soft anal fin rays from the total number of gill rakers distinctly separates *fucata* from *lineolata*, as indicated in the following frequency distribution:

Species	Total number of gill rakers minus number of soft anal rays							
	3	4	5	6	7	8	9	10
<i>fucata</i> .....	8	15	12					
<i>lineolata</i> .....					4	16	9	1

Color differences were observable when a series of specimens of each species were simultaneously compared. In *Archamia lineolata* (pl. 17, a) the black caudal spot is smaller and more intensely developed



than in *A. fucata* (pl. 17, *b*). The general body color appears to be a slightly lighter tan in *fucata* and more dusky in *lineolata*. The caudal spot varies to such an extent in intensity that in a single collection certain specimens show gradations from plainly discernible to faintly visible spots, or they may be obsolete. Both these species are widely distributed. The synonymy listed for each illustrates the confusion among many of the earlier workers. Descriptions were only general and meager, and often of a single specimen, and the salient characters were not critically studied. The variability of certain color marks was not understood. For example, the spot at the base of the caudal fin varies so considerably in intensity as to be completely obscure in some specimens of *fucata* and *lineolata*, and even in a few specimens of *A. biguttata*, yet the humeral spot is always intensely developed in *biguttata*. Thus, such writers as Jordan and Snyder (1901, p. 907) recognized *A. kagoshimana*, a manuscript name of Döderlein (*in* Steindachner and Döderlein, 1884, p. 3), on the basis of the absence of the caudal spot in a single specimen and the fact that it was taken in the Japanese faunal area.

Prof. L. Bertin, Muséum National d'Histoire Naturelle, Paris, sent word that no type material of *Apogon macropterus* Cuvier and Valenciennes is at that museum, and that probably no type was designated, as Cuvier and Valenciennes used a manuscript name of Kuhl and Van Hasselt. From the above discussion of the *fucata-lineolata* complex and the distribution of the anal-fin-ray counts (table 2), it is almost certain that *Apogon macropterus* Cuvier and Valenciennes equals *Apogon lineolatus* Cuvier and Valenciennes. Günther's description (1859, p. 245) of *Apogon bleekeri* contained no diagnostic data. The number of anal fin rays was said to range from II, 14 to II, 17. This distribution overlaps that of *fucata* and *lineolata*, and it is doubtful which species he examined, since no color marking is indicated other than the presence of a caudal spot. Dr. E. Trewavas, British Museum, has informed me that the type of *Apogon bleekeri* Günther cannot be located.

I am unable to determine the status of *Archamia macroptera* and *A. lineolata* of Smith (1949, pp. 208–209, pl. 23, figs. 489 and 490). Prof. J. L. B. Smith informs me that the two horizontal body stripes of his figure of *macroptera* are life colors and are "virtually invisible" after a day of preservation. The anal-ray count that he reported for this species (*ibid.*, p. 208), II, 14 to 17, represented the range of his data and also that of "Day (Fishes of India, pt. 1, p. 64, pl. 17, fig. 4, 1875) and Fowler" (publication not given). Three adult specimens received from Smith, collected in Delagoa Bay, East Africa (U.S.N.M. No. 112206) have anal fin rays numbering II, 14 (2 specimens) and II. 15 and gill rakers numbering 5+1+16. These statistics correlate

with my discussion of *A. lineolata*. The blackish, circular spot at the base of the caudal fin in Smith's specimen is distinct and small, its diameter about four times in the least depth of the caudal peduncle, so it is perceptibly smaller than in specimens of *lineolata* from the East Indies and Philippine Islands. His specimens may represent a distinctly new form. The spot in Smith's figure of *macropterus*, however, measures about three times in the depth of the caudal peduncle.

The account of *lineolata* by Smith (ibid., p. 209) lists the anal fin rays as ranging from II, 13 to 17 and his figure may be interpreted as having either II, 14 or II, 15 anal rays, with a distinct spot at the base of the caudal fin, its depth about three times in the least depth of the caudal peduncle. The range of the anal fin rays almost certainly refers to both *lineolata* and *fucata*. The size and intensity of the caudal spot are characteristic of *lineolata*. Sufficient specimens are not available from the east African area to determine whether his account refers to *lineolata*, *fucata*, or both.

#### STUDIES OF THE APOGON BANDANENSIS GROUP

This group is distinguished from other species of *Apogon* by the combination of the following characters: Dorsal fin rays VII-I, 9; anal rays II, 8; pectoral rays 12 to 14; lateral line scales 22 to 26; total number of gill rakers ranging from 23 to 30; palatines with villiform teeth; posterior margin of preopercle serrated, anterior margin of preopercle not serrated; lateral line complete; third spine of spinous dorsal longest; caudal fin emarginate or slightly forked; a band, saddle, or saddlelike spot on peduncle at base of caudal fin; a characteristic mark, narrow and elongate or triangular shaped (fig. 105, *a* and *b*) from eye to angle of anterior margin of preopercle; body, head, and fins otherwise without stripes or bars.

The data derived from a careful study of collections in the United States National Museum indicate that more than two species were confused and included in this group by relatively recent workers. An examination of the collections concerned in such studies as Fowler and Bean (1930, pp. 40-44), Jordan and Seale (1906, pp. 239-240), and Schultz (1943, pp. 92 and 95) revealed the presence of more than one species. Four species are now recognized. The group is distinctly divisible into two categories: 1, Species with a large triangular mark below the eye (fig. 105, *a*); 2, a species with a narrow, elongate almost rectangular mark below the eye (fig. 105, *b*). The following species with a triangular mark below the eye are recognized: *Apogon erdmani*, new species, *Apogon bandanensis* Bleeker, and *Apogon savayensis* Günther. In the latter category *Apogon nubilus* Garman

is placed. The significant characters differentiating the species of this group are listed in tables 5 and 6, discussed in the accounts of the species, and portrayed on plates 18, *a* to *c*, and 19.

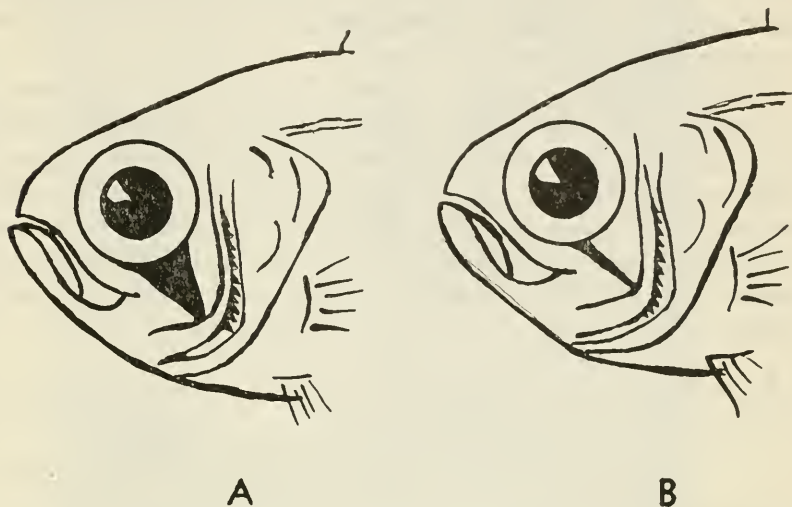


FIGURE 105.—Sketch showing: *a*, Triangular cheek mark in *Apogon savayensis* Gunther; *b*, narrow elongate mark in *A. nubilus* Garman.

**APOGON ERDMANI, new species**

PLATE 18, *a*

*Holotype*.—U.S.N.M. No. 147518, a female specimen, 60 mm. in standard length, collected by Donald S. Erdman, July 2, 1946, at Jidda, Red Sea.

*Paratypes*.—U.S.N.M. No. 112040, 21 specimens, 39 to 59 mm. in standard length, taken with holotype and bearing same data. U.S.N.M. No. 147522, a specimen 47 mm. in standard length, collected by Erdman and Azizz, July 14, 1948, at Jidda, Red Sea.

*Description*.—This description is based on the holotype and paratypes listed above. The counts are recorded for the holotype and followed by data from 10 paratypes in parentheses. When the counts for the paratypes are identical with those of the holotype, but one number is given. Dorsal rays VII–I, 9; anal rays II, 8; pectoral rays 13; lateral line scale rows 23 (23 to 24); scales above lateral line 2; scales below lateral line 6. Measurements for the holotype and 7 paratypes are presented in table 4.

Gill rakers  $8+1+20$  (6 to  $8+1+18$  to 21, total 25 to 30); third spine of spiny dorsal longest, about twice in head length; second spine less than one-half length of third spine; first spine minute, less than one-fifth length of second spines; second anal spine about equal to length of third dorsal spine; posterior margin of preopercle finely

serrated, anterior margin smooth; no suborbital serrations; scales ctenoid with 10 to 12 radii in anterior field only; upper jaw reaches vertical drawn through middle of eye; lateral line complete; longest gill raker twice as long as longest filament, and about twice in diameter of eye; a single, flat opercular spine.

Villiform teeth in jaws, vomer, and palatines; those in upper jaw in a wide band; a wide patch or band anteriorly in lower jaw, reduced to two irregular rows posteriorly; teeth on vomer in a narrow patch; palatines with a single row; body comparatively deeper in adults; caudal fin emarginate; contour of soft dorsal and anal fin convexly rounded, pectoral moderately rounded; depressed spiny dorsal fin reaches origin of soft dorsal in some specimens; pelvic fins extend beyond vent, reaching anal origin in some specimens.

TABLE 4.—*Measurements expressed in thousandths of the standard length of Apogon erdmani*

Measurement	Holo-type	Paratypes (U.S.N.M. No. 112040)							
		58	54	43	39	59	55	44	
Standard length, mm.....	60	58	54	43	39	59	55	44	
Sex.....	♀	♂	♂	♂	♂	♀	♀	♀	
Greatest body depth.....	454	491	482	477	433	491	500	437	
Body width.....	183	214	204	186	179	214	182	184	
Head length.....	434	431	463	466	433	431	418	425	
Head depth at occiput.....	366	362	404	372	359	362	382	368	
Length of caudal peduncle.....	233	250	241	221	231	250	245	241	
Least depth of caudal peduncle.....	183	190	204	186	179	190	191	184	
Length of longest pectoral ray.....	267	284	306	279	282	284	291	299	
Length of third spine of spinous dorsal.....	175	190	185	209	192	190	200	214	
Diameter of eye.....	167	172	185	174	179	172	163	172	
Length of upper jaw.....	171	233	232	221	231	233	227	214	
Length of snout.....	92	86	93	93	103	86	82	92	
Least width of bony interorbital.....	117	103	110	116	103	103	109	115	
Tip of snout to origin of spinous dorsal fin.....	442	448	463	466	433	448	452	437	
Tip of snout to origin of anal fin.....	708	690	685	698	680	690	691	690	
Tip of snout to insertion of pectoral fin.....	404	397	426	395	410	397	391	414	
Tip of snout to insertion of pelvic fin.....	425	431	426	442	433	431	418	437	
Tip of snout to anal opening.....	666	621	667	651	628	621	654	652	

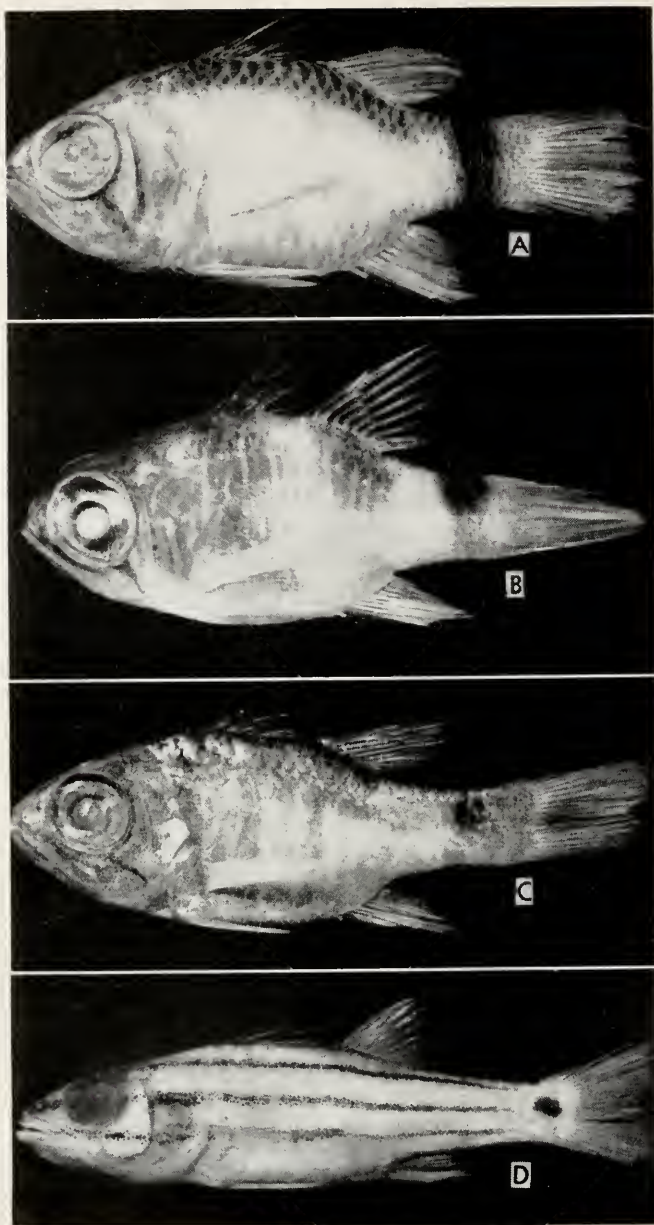
*Color in alcohol.*—Body and head light to dusky in smaller specimens to dusky or blackish in larger ones; a conspicuous black triangular mark extending from below eye to angle of anterior margin of preopercle; a characteristic black band encircling caudal peduncle at base of caudal fin; pectoral and pelvic fins transparent to dusky; dorsal, anal, and caudal fins dusky; Donald S. Erdman, collector of these specimens, reported to me that this species possessed no other outstanding colors when alive, and that the dusky to blackish body colors were somewhat lighter and silvery.

Named *erdmani* in honor of the collector, Donald S. Erdman.

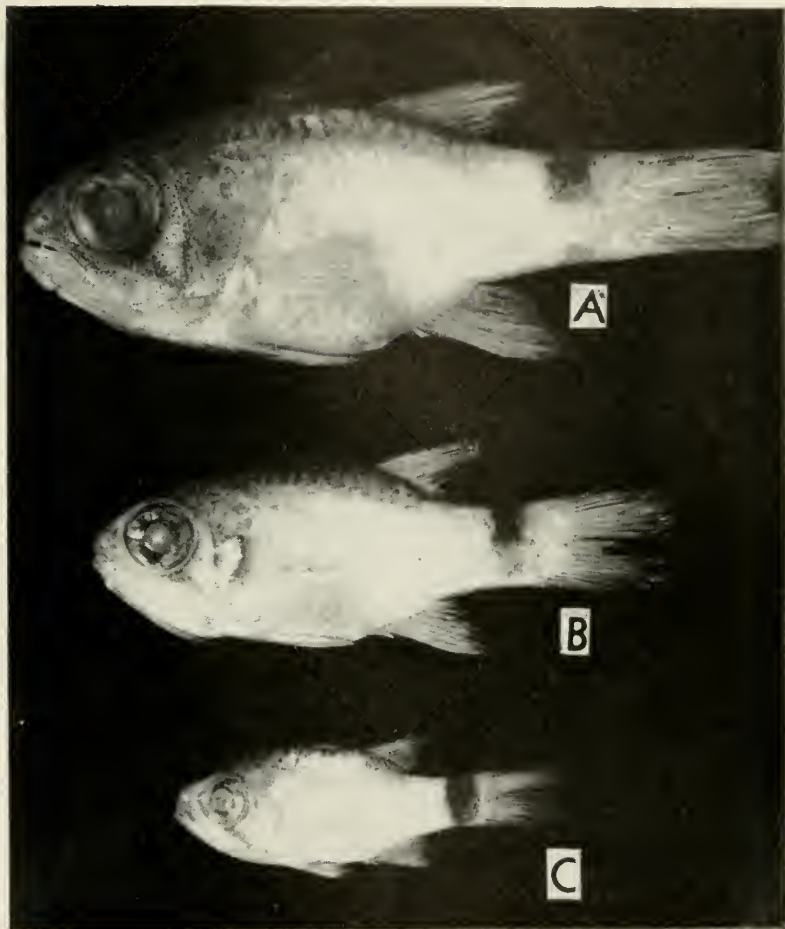




The location and intensity of certain spots found on the bodies of four species of *Archamia*: A, *A. lincolata* (Cuvier and Valenciennes), with moderately developed spot at base of caudal peduncle, 56 mm. in standard length, from Makyan Island, East Indies. B, *A. fucata* (Cantor), with a diffuse spot at base of caudal fin, 53 mm. in standard length, from Bagay Gulf, Philippine Islands. C, *A. dispilus*, new species, holotype, U.S.N.M. No. 112041, 58 mm. in standard length, from Soo Wan Bay, Formosa. Note diffuse spots on body just posterior to opercular flap and at base of caudal fin. D, *A. biguttata*, new name, with intensely developed humeral and caudal peduncular spots, 60 mm. in standard length, from Luzon, Philippine Islands.



A, *Apogon crdmani*, new species, holotype, U.S.N.M. No. 147518, 60 mm. in standard length, from Jidda, Red Sea. B, *A. bandanensis* Bleeker, 54 mm. in standard length, from Busuanga Island, Philippine Islands. C, *A. nubilus* Garman, 63 mm. in standard length, from the northern Marshall Islands. D, *Paramia bipunctata*, new species, holotype, U.S.N.M. No. 147944, 47 mm. in standard length, from the Persian Gulf.



*Apogon savayensis* Günther, from the northern Marshall Islands, showing reduction in size of mark at base of caudal fin, from a band in young to a saddle-like mark in adults. A, Adult 71 mm. in standard length. B, Juvenile, 51 mm. in standard length. C, Small specimen, 34 mm. in standard length.





## APOGON BANDANENSIS Bleeker

## PLATE 18, b

*Apogon bandanensis* BLEEKER, 1854, p. 95 (type locality, Banda Island) ; 1873-76, p. 82; 1876-77, Perc. 67, tab. 345, fig. 2.

*Amia bandanensis* FOWLER and BEAN, 1930, p. 40 (in part).

*Specimens studied.*—U.S.N.M. No. 112129 to 112136, 112161 to 112196, 89 specimens, 36 to 65 mm., collected during 1908-09 in the East Indies and Philippine Islands (*Albatross* expedition).

*Description.*—The tabulated statistics comparing counts and measurements of various structures among these four species, other than those pertaining to the gill rakers, show little or no differences, and will receive no further treatment. The extent of the development of the serrations on the posterior margin of the preopercle, as well as the development of the villiform teeth of the jaws, is almost identical.

*Color in alcohol.*—Head and body brown dorsally, light brown ventrally; some coppery-blue iridescence on cheek, opercle, and side of body; a brown triangular mark extending from lower margin of eye to angle of anterior margin of preopercle; sides of body sometimes with narrow, silvery vertical bars, interspaced with wide light-brown bars; two saddles on body, their width about three-fourths in diameter of eye, one passing through spinous dorsal fin and the other through soft dorsal fin; these saddles extend from the fin bases to about midbody area; anterior saddle almost completely faded in about 30 percent of specimens examined; saddle through spinous dorsal (posterior saddle) almost completely faded in about 5 percent of specimens examined; a dark brown saddle over caudal peduncle at base of caudal fin in larger adults, sometimes with traces of a lower portion forming a band; in smaller specimens (under 50 mm.) saddle extends below lateral line forming a complete band, and the portion of band below lateral line is a light brown and not so intensely developed as the more intense, darker brown, upper portion; a conspicuous dark brown streak on the two outer branched caudal rays margined by clear to white color on the unbranched caudal ray; remainder of caudal fin dusky to clear; in about 20 percent of specimens the dark brown outer streak is not present and it is not certain if this is due to fading, immaturity, sexual dimorphism, or a combination of all three factors; the plain, brown caudal fin occurred in the smaller specimens (under 50 mm.) and was found in more females than males in more than 10 specimens of each sex examined; it was also noted that the males had a more intense development of the saddles; these are but tentative assumptions, for too few specimens could be sexed because of their poor preservation and years of storage; in many specimens the outer rays of the caudal fin, as well as of the other fins, were frayed and broken; the pectoral,

pelvic, soft dorsal, and anal fins are clear to slightly dusky; the anterior portion of spinous dorsal dusky to black, remainder of fin clear.

*Range*.—East Indies and the Philippine Islands.

*Remarks*.—See *Remarks* under *A. savayensis* (p. 599) for a discussion of the relationships among *bandanensis*, *savayensis*, and *erdmani*.

APOGON SAVAYENSIS Günther

PLATE 19, a-c

*Apogon savayensis* GÜNTHER, 1871, p. 656 (types from Savay, Samoa, and Mando, Celebes; 1873, p. 21, tab. 19, fig. b).

*Amia savayensis* JORDAN and SEALE, 1906 p. 239.

*Amia bandanensis* FOWLER and BEAN, 1930, p. 40 (in part).

*Apogon bandanensis* SCHULTZ, 1943, p. 95 (in part).

*Specimens studied*.—U. S. N. M. Nos. 112234 to 112241 and 126373, totaling 13 specimens, 48 to 75 mm., all collected during 1908–09 in the East Indies and Philippine Islands by the *Albatross* expedition except No. 126373, which was collected by Pierson in 1903; U. S. N. M. Nos. 142414 to 142417 and 142428, 40 specimens (56 additional specimens not cataloged), 19 to 60 mm., July to September 1946, northern Marshall Islands (Brock, Donaldson, Herald, and Schultz); U. S. N. M. Nos. 126257, 52432, and 58522, totaling 30 specimens, 42 to 70 mm., 1902, Samoan Islands (Jordan and Kellogg); U. S. N. M. No. 82953, 1 specimen, 65 mm., Samoan Islands (Wilkes Exploring Expedition); U. S. N. M. No. 65426, 7 specimens, 67 to 78 mm., February 1904, Manga Reva, Tuamotu Archipelago (*Albatross* expedition); U. S. N. M. No. 82795 and 82796, totaling 3 specimens, 45 to 65 mm., Fiji or Oahu (Wilkes Exploring Expedition).

*Color in alcohol*.—Body and head light tan to dusky, head more dusky; in some specimens body, laterally, with about six vertical narrow silvery bars, separated by wider dusky bars; these vertical bars are often irregular or may be completely absent; three characteristic markings are: (1) a large triangular or wedge-shaped dark-brown mark extending from below eye to angle or slightly above angle of anterior margin of preopercle (slightly more horizontally directed than in *bandanensis*); (2) a dark-brown saddle at base of caudal fin, not extending below lateral line in adults; this saddle begins in young and juveniles as an almost complete band extending below lateral line and nearly encircles caudal peduncle, but as the specimens increase in size the band gradually atrophies into a saddle; and (3) a conspicuous dark brown streak in the outer two-branched caudal rays; the outermost unbranched caudal ray is usually clear or white and is in contrast with the dark brown streak; pectoral, pel-

vic, soft dorsal, and anal fins clear to slightly dusky; anterior and outer portion of spinous dorsal blackish, remainder of fin dusky to clear; caudal, other than dark brown streak, faintly dusky to clear.

*Range*.—On the basis of United States National Museum collections, *savayensis* ranges from the Philippine Islands eastward among the islands of Oceania (Marshall, Samoan, Tuamotu, Fiji), where it is commonly taken with *nubilus*.

*Remarks*.—Examination of more than several hundred specimens of this group from Oceania failed to reveal a single one having the dorsal saddles developed as in *bandanensis*. Some specimens from the Philippine Islands were not determinable, owing chiefly to their small size or faded condition. The young and some juveniles of *savayensis* and *bandanensis* have the caudal saddle, typical of the adults, extending below the lateral line forming a band nearly encircling the peduncle (pl. 19, *a* to *c*). When small specimens of *bandanensis* had the body saddles seriously faded, such specimens could not be distinguished from those of *savayensis* with certainty. Many of these small specimens were distinguished by the caudal band, which in *savayensis* progressively atrophies into a saddle with increase in size of the specimens, but which in *bandanensis* does not completely atrophy, becoming only lighter in color and less distinct in the area below the lateral line.

Some adult specimens from the East Indies and Philippine Islands were also not identifiable because of their faded or intermediate color patterns. Although a considerable overlap occurred in the frequency distributions of the number of gill rakers between *savayensis* and *bandanensis* from these areas (table 5), the consistently higher number found in *savayensis* often aided in separating partially faded specimens. The following adult specimens from the East Indies and Philippine Islands are questionable determinations referred to the species *bandanensis*: U. S. N. M. Nos. 112164, 112169, 112171, 112176, 112177, 112182, 112186, and 112190. The two collections, U. S. N. M. No. 112132 from the Philippine Islands and 123476 from the Solomon Islands, could not be identified. These specimens are intermediate in coloration between *erdmani*, *bandanensis*, and *savayensis*. The caudal fin is a more or less uniform light brown. The first body saddle through the spinous dorsal is absent and a trace of a saddle through the soft dorsal is sometimes present. The caudal peduncle mark sometimes resembles the complete band found in *erdmani*. In some specimens the lower portion of the band below the lateral line is of a lighter color than that portion above the lateral line. The assumption that these three forms might be considered as subspecies



on the basis of these intermediate specimens was discarded. Since these intermediate specimens were taken over a wide area including certain islands of the East Indies, Philippines, and Solomons, one must assume that they represent intergrades between two forms occupying different habitats. A search for ecological data from the literature and *Albatross* records revealed no relationships between color form and habitat, nor were any significant differences found in habitats occupied by the four species. It is suspected that color differences owing to sexual dimorphism may exist in *bandanensis* and this factor may, in part, be associated with these intermediate-colored specimens. More study with freshly collected material from the East Indies and Philippine Islands is required.

*A. savayensis* probably attains the largest average size of this group, reaching a maximum length of about 80 mm. The young appear to be more elongate and less deep than the young of the other three species.

**APOGON NUBILUS Garman**

**PLATE 18, c**

*Apogon nubilus* GARMAN, 1903, pp. 229-230, pl. 1, fig. 1 (type locality, Suva, Fiji Islands).

*Amia bandanensis* FOWLER and BEAN, 1930, p. 40 (in part).

*Apogon bandanensis* SCHULTZ, 1943, p. 95 (in part).

*Specimens studied*.—U.S.N.M. Nos. 147519, 147523, 147524, and 112046, totaling 62 specimens, 14 to 65 mm., July 1948, Red Sea (Erdman); U.S.N.M. Nos. 112197 and 112050 to 112062, totaling 23 specimens, 21 to 71 mm., 1908-09, East Indies and Philippine Islands (*Albatross* expedition); U.S.N.M. Nos. 71562, 7 specimens, 26-42 mm., 1906, Ryukyu Islands (*Albatross* expedition); U.S.N.M. No. 132681, 1 specimen, 30 mm., July 28, 1945, Ryukyu Islands (Simon); U.S.N.M. Nos. 112347 to 112352, totaling 229 specimens, and an additional 86 specimens not cataloged, 9 to 79 mm., 1946-47, northern Marshall Islands (Brock, Donaldson, Herald, Hiatt, and Schultz); U.S.N.M. No. 152947, 2 specimens, 61 and 63 mm., August 20-22, 1949, Likiep Atoll, Marshall Islands (Univ. Washington); U.S.N.M. No. 139811, 3 specimens, 22 to 34 mm., June 1945, Saipan, Marianas (Shroyer and White); U.S.N.M. No. 139811, 34 specimens, 36 to 63 mm., November 26, 1945, Guam, Marianas (Frey); U.S.N.M. No. 139799, 3 specimens, 16 to 22 mm., December 11, 1945, Rota Island, Marianas (Frey); U.S.N.M. No. 150008, 19 specimens, 20 to 30 mm., December 19, 1948, Saipan, Marianas (picked from head of brown *Acropora*) (Cloud, Schmidt, and Flatt); U.S.N.M. No. 151451, 4 specimens, 52 to 64 mm.,



November 29, 1945 and January 8, 1946, Guam, Marianas (Gressitt and Ingram); U.S.N.M. No. 151452, 37 specimens, 42 to 72 mm., December 23, 1945, Guam, Marianas (Gressitt and Frey); U.S.N.M. No. 114973, 4 specimens, 41 to 61 mm., June 3, 1939, Tutuila Island, Samoa (Schultz); U.S.N.M. No. 112047, 11 specimens, 26 to 50 mm., Apia, Samoa (Jordan and Kellogg); U.S.N.M. No. 112048, 11 specimens, 21 to 59 mm., Pago Pago, Samoa (Jordan and Kellogg); U.S.N.M. No. 112198, 6 specimens, 28 to 61 mm., Apia, Samoa (Jordan and Kellogg); U.S.N.M. No. 114974, 47 specimens, 9 to 41 mm., July 8–12, 1939, Hull Island, Phoenix Islands (Schultz); U.S.N.M. No. 114975, 14 specimens, 41 to 64 mm., May 25–26, 1936, Canton Island, Phoenix Islands (Schultz); U.S.N.M. No. 114972, 76 specimens, 34 to 61 mm., May 23–25, 1939, Canton Island (Schultz); M.C.Z. No. 28315, holotype, Fiji Islands.

*Color in alcohol.*—Body and head dusky to light silvery to dusky brown; some specimens with 6 to 8 vertical silvery bars separated by wider dusky vertical bars; dark mark extending from below eye to angle of preopercle elongate and narrow, about the same width below the eye as at the angle of the preopercle; a diffuse dusky spot at base of caudal fin just above lateral line in adults, never developed over dorsal part of caudal peduncle to form a saddle; sometimes only faintly visible or obsolete; caudal spot diffuse in young and juveniles, located at midbase of caudal fin and equally divided by lateral line in specimens ranging in size up to about 20 mm.; in specimens about 30 to 35 mm. in length the spot begins to migrate dorsally, more of it being above the lateral line than below; fry under 15 mm. have melanophores in 3 to 4 horizontal rows on the body and irregularly scattered on the head; upper portion of membrane of spinous dorsal blackish, more so between third and fifth spines; remainder of spinous dorsal and other fins light dusky to clear.

*Color in life.*—From Kodachrome transparency taken in the Marshall Islands under the direction of Dr. L. P. Schultz: Body laterally dusky to purple with irregular vertical silvery stripes; belly dusky to silvery with some purple; head deep purple; pectoral fin transparent and colorless; membrane between third to fifth spine of spiny dorsal light bluish, remainder dusky to light brown; soft dorsal and anal transparent to light brown, darker brown near bases; anal light brown to transparent.

*Range.*—This species has an extensive range, represented in the United States National Museum collection from the Red Sea to the Islands of Oceania (Marshall, Marianas, Phoenix, Samoan, Fiji) and the Ryukyu Islands.

*Remarks.*—Examination of the holotype of *A. nubilus* (M. C. Z. No. 28315) and of Garman's illustration leaves no question as to which species he studied, for the elongate mark below the eye is clearly visible, as is a blackish spot above the middle of the base of the caudal fin. Specimens ranging from the Red Sea to the Phoenix and Samoan Islands, when considered geographically, showed little variation in coloration, body form, and meristic characters. Those from the Red Sea average about one to two gill rakers more than specimens from other areas of the Indo-Pacific (table 5). Although

TABLE 5.—Frequency distributions of the total number of gill rakers in four species of Apogon

Species and locality	Total number of gill rakers on first gill arch							
	23	24	25	26	27	28	29	30
<i>erdmani</i> , new species, Red Sea.....			1	2	11	6	2	1
<i>bandanensis</i> Philippine Islands and East Indies.....		1	17	18	8	1		
<i>savayensis</i>								
Philippine Islands.....					8	1	1	
Northern Marshall Islands.....				5	4	5	2	
Samoa.....				1	3	8	4	4
Manga Reva.....					6	5	5	1
Totals for <i>savayensis</i> .....				6	21	19	12	5
<i>nubilus</i>								
Red Sea.....		2	1	12	6	4	1	
Philippine Islands and East Indies.....	1	4	5	6	1			
Okinawa.....		2	2	2				
Northern Marshall Islands.....	1	2	8	5	1		1	
Marianas Islands.....		1	7	10		1		
Phoenix.....		3	6	6	1			
Samoa.....		2	3		1			
Fiji.....			1					
Totals for <i>nubilus</i> , except from Red Sea.....	2	14	32	29	4	1	1	

Bleeker in his discussion (1854, p. 95) did not mention the characteristic mark below the cheek, he did include a rather narrow elongate mark in his figure, somewhat similar to that found in *nubilus*. It is possible, therefore, that Bleeker may have had specimens of *nubilus* as well as of *bandanensis*. The saddles passing through the spiny and soft dorsal fin certainly characterize his *bandanensis*. Günther (1871) points out that the cheek mark on his Samoan specimen (2½ inches in length) was "more distinct" than in specimens (3½ inches in length) from Manado, Celebes. Since the larger specimens had the smaller cheek mark, it is possible that Günther, too, had *nubilus*.

Several male specimens, 60 to 68 mm. in length, were found practicing oral incubation.

In summary, it is of interest to note that in the one division of this closely related group (*erdmani*, *bandanensis*, *savayensis*) differentiation has been complete to the species level in three areas, more

TABLE 6.—*Color and color patterns differentiating four species of Apogon*

Character	Species			
	<i>erdmani</i>	<i>bandanensis</i>	<i>soroyensis</i>	<i>nubilus</i>
Cheek mark extending from eye to angle of anterior margin of preopercle.	Triangular, oblique direction.	Triangular, oblique direction	Triangular, slightly more horizontal.	Narrow, elongate, oblique direction.
Saddles over body, passing through bases of spiny and soft dorsal.	Always absent.	Present	Always absent.	Always absent.
Mark at base of caudal fin on caudal peduncle.	An intense brownish black band encircling caudal peduncle in young to adults.	A dark brown saddle over caudal peduncle in adults, extending to lateral line; tending to form a band almost encircling peduncle in young and juveniles, and faintly visible in adults.	A dark saddle over caudal peduncle in adults, reaching down to lateral line; a band almost encircling peduncle in young and some juveniles; the band of the young atrophies to a saddle in adults.	A diffuse dark spot on peduncle distinctly above midbase of caudal fin in adults, not forming a saddle; in young the tiny spot is at midbase of caudal fin, but divided equally by lateral line, but migrates above lateral line with increase in size.
Color of caudal fin	Almost uniform dusky; in some a little heavier dusky on outer rays.	Outer rays blackish edged in white; remainder of fin dusky.	Outer rays blackish edged in white; remainder of fin dusky.	Uniformly dusky.
Faint dusky and silvery vertical bands on body.	Absent.	Sometimes present.	Sometimes present.	Sometimes present.

or less, of the Indo-Pacific (the Red Sea, East Indies-Philippines, and Oceania). In the other division a single species exists throughout the Indo-Pacific with possible racial differentiation in the Red Sea.

## STUDIES OF THE GENUS PARAMIA

### Genus *PARAMIA* Bleeker

*Paramia* BLEEKER, 1863, p. 233. (Genotype, *Cheilodipterus quinquelineatus* Cuvier and Valenciennes.)

*Jadamga* SCHULTZ, 1940, p. 416. (Genotype, *Cheilodipterus quinquelineatus* Cuvier and Valenciennes.)

The genus *Paramia* is most closely related to *Cheilodipterus* Lacepède and *Cheilodipterops* Schultz. One or two symphyseal canines are present on each side of the tip of the lower jaw in the latter genus, these being absent in the former. The villiform teeth of the lower jaw in *Paramia* extend from the symphysis posteriorly, interrupted on each side by 2 to 6 enlarged canines. In this and other characters it is nearly identical with *Cheilodipterops*. In *Cheilodipterus* the band of villiform teeth in the lower jaw is wanting.

It is interesting to note the addition of a new species from the Persian Gulf to this genus, hitherto known as monotypic.

### KEY TO THE SPECIES OF PARAMIA

1a. A black circular spot on dorsal side of caudal peduncle just before procurent rays of caudal fin, with diameter about six times in least depth of caudal peduncle; five horizontal stripes on the body, counting the stripe on the midventral area located between pelvic bases, and the one on the mid-dorsal side; snout shorter, length 2.8 to 3.0 in length of base of dorsal fin; least depth of caudal peduncle, in snout, extends well beyond tip; eye smaller, about 1.0 in snout, 3.2 to 3.5 in head length, 2.9 to 3.0 in length of base of dorsal fin; black spot at base of caudal fin oval and larger, greatest diameter less than 2.5 in least depth of caudal peduncle.

*P. bipunctata*, new species

1b. No spot on dorsal side of caudal peduncle; six horizontal body stripes, counting midventral and middorsal stripes; snout longer, length less than 2.5 in length of base of dorsal fin; caudal peduncle depth in snout usually touches tip or extends only slightly beyond snout; eye larger, about 0.9 in snout, 3.0 to 3.3 in head length, 2.2 to 2.8 in length of base of dorsal fin; black spot at base of caudal fin nearly circular and smaller, diameter more than 3.0 in least depth of caudal peduncle.

*P. quinquelineata* (Cuvier and Valenciennes)

### *PARAMIA BIPUNCTATA*, new species

#### PLATE 18, d

*Holotype*.—U.S.N.M. No. 147944, a specimen 47 mm. in standard length, collected by Donald S. Erdman, June 7, 1948, in Tarut Bay, Ras Tanura, Persian Gulf, Saudi Arabia.



*Paratypes*.—U.S.N.M. No. 112039, 2 specimens, 44 and 48 mm. in standard length, taken with the holotype and bearing same data.

*Description*.—This description is based on the holotype and two paratypes listed above. The counts and measurements are recorded for the holotype followed in parentheses by data from the paratypes, the smaller paratype listed first. Measurements are expressed in thousandths of the standard length. Where data are identical with that of the holotype but one number is given.

Dorsal rays VI–I,9; anal rays II,8; pectoral rays ii, 8, ii; lateral line scale rows 23; scale rows above lateral line 2; scale rows below lateral line 6.

Greatest body depth 298 (273, 292); body width 159 (170, 167); head length 371 (386, 396); head depth at occiput 238 (227, 229); length of caudal peduncle 255 (273, 272); least depth of caudal peduncle 117 (114, 125); length of longest pectoral ray 216 (227, 229); length of third spine of spiny dorsal 170 (182, 167); diameter of eye 106 (125, 125); length of upper jaw 170 (182, 181); length of snout 86 (91, 83); least width of bony interorbital 64 (68, 64); tip of snout to origin of spiny dorsal fin 404 (431, 416); tip of snout to origin of anal fin 638 (658, 666); tip of snout to insertion of pectoral fins 372 (375, 375); tip of snout to insertion of pelvic fins 383 (386, 396); tip of snout to anal opening 544 (523, 562); gill rakers 3,3+1+10,4 (4,3+1+11,2; 3,3+1+11,2).

First spine of spiny dorsal about three-fourths length of second spine; second spine about as long as third spine; first anal spine short, about one-seventh length of second; second anal spine about as long as first spine of spiny dorsal and equals diameter of eye; posterior margin of preopercle finely serrated, anterior margin smooth; scales ctenoid, with 6 to 10 radii; female specimen 48 mm. in standard length, with a short conical genital papilla; upper jaw reaches vertical drawn through middle of eye; lateral line complete; longest gill raker  $1\frac{1}{2}$  to  $1\frac{3}{4}$  longer than longest filament,  $2\frac{1}{2}$  times in diameter of eye; peritoneum transparent with pepperlike spots; holotype with enlarged scale between the bases of the pelvic fins, lost in the paratypes.

Dentition pattern of the jaws similar to that as illustrated by Schultz (1940, p. 418, fig. 20, *c*). The lower jaw has from five to seven canine teeth on each side and the anterior portion of the jaw has a wide band of villiform teeth, typical of the genus. In the upper jaw, just posterior to a small patch of villiform teeth opposite each side of the symphysis, is found a group of from two to three canines. Vomer and palatines with small rounded to pointed villiform teeth.

Body elongate and somewhat slab sided; snout conical; caudal fin forked; contour of soft dorsal and anal fins apparently rounded; depressed spiny dorsal fin reaches anterior base of soft dorsal; pelvics reach vent but not origin of anal fin; all specimens immature.

*Color in alcohol.*—Body and head colored pale green with five horizontal blackish stripes; a middorsal stripe begins just behind inter-orbital area, passing posteriorly, dividing at origin of spiny dorsal, reuniting at end of soft dorsal and extending on caudal peduncle to spot on dorsal aspect of caudal peduncle and procurent rays of caudal fin; a dorsolateral stripe extends from tip of snout, touching dorsal margin of eyes and anterior lateral line on body, dorsolaterally to area just before end of caudal peduncle; a median stripe begins at tip of snout and passes through middle of eye extending almost to spot at midbase of caudal fin; a ventrolateral stripe extends from tip of lower jaw through middle of upper jaw, touching lower margin of eye through base of pectoral and extending ventrolaterally to area just before end of peduncle; a midventral stripe extends from area anterior to midbelly, between bases of pelvics, dividing before vent and encircling anal fin, reuniting at end of anal and passing ventrally to end of caudal peduncle; a faint line is found on each side of isthmus extending from each side of tip of lower jaw to lower angle of preopercle; another faint line extends, on each side, obliquely forward on body from lateral base of pelvic to area just forward of pectoral base, and thence posteriorly to pectoral base; ventral stripe narrowest, only one-half as wide as other body stripes; width of median stripe at midbody about twice in diameter of pupil; a circular, black spot just before procurent rays of caudal fin on dorsal aspect, its diameter about 6 times in least depth of caudal peduncle and about twice in pupil; a blackish oval spot at midbase of caudal fin, its greatest diameter on the horizontal axis about once in pupil, and encircled by a pigmentless area; some scattered melanophores on the upper parts of the membranes of the first two dorsal spines, remainder of fins transparent.

*Color in life.*—The following colors recorded in the field by Donald S. Erdman: Body silvery white with black stripes; black spot at midbase of caudal encircled by a yellow ring, its diameter equal to least depth of caudal peduncle.

Named *bipunctata*, in reference to the two spots on the caudal peduncle.

*Ecology.*—These specimens were taken by Donald S. Erdman at night near shore with a 100-foot drag net in shallow water over a sandy bottom.

PARAMIA QUINQUELINEATA (Cuvier and Valenciennes)

*Cheilodipterus quinquelineatus* CUVIER and VALENCIENNES, 1828, p. 167 (type locality, Borabora, Society Islands); FOWLER and BEAN, 1930, p. 127 (in part).

*Specimens studied.*—U.S.N.M. Nos. 150471 to 150519, 87 specimens, 1908–09, East Indies and Philippine Islands (*Albatross* expedition).

U.S.N.M. Nos. 150451, 17 specimens, April 1908, Catbalogan, Samar, Philippine Islands (*Albatross* expedition); U.S.N.M. Nos. 142450 to 142454, totaling 104 specimens, 1946 and 1947, northern Marshall Islands (Brock, Donaldson, Emmory, Herald, Kohler, Schultz) (also 28 specimens, not cataloged, from northern Marshall Islands collected by same party); U.S.N.M. Nos. 114977 to 114980, 40 specimens, May to July, 1939, Tutuila and Canton Island (Schultz); U.S.N.M. Nos. 52296 and 126286, totaling 10 specimens, 1902, Apia, Samoa (Jordan and Kellogg); U.S.N.M. No. 65976, 1 specimen, 1899–1900, Papeete Island, Society Islands (*Albatross* expedition).

*Description.*—The following counts and measurements were taken from 7 specimens, 32 to 76 mm.: Dorsal rays VI–I, 9; anal rays II, 8; pectoral rays ii, 8 or 9, ii; vertical scale rows 24 or 25; scale rows above lateral line 2; scale rows below lateral line 6 or 7.

Body depth 3.3 to 3.8; head length 2.4 to 2.5; length of caudal peduncle 3.7 to 4.0; length of longest pectoral ray 4.5 to 5.0 all in standard length; eye 3.0 to 3.3; length of upper jaw 2.0 to 2.1; least depth of caudal peduncle 3.0 to 3.2; snout 3.5 to 3.7; width of bony interorbital 6.3 to 7.2 all in length of head; eye in snout 0.9; second spine of spinous dorsal longest, about 3.1 to 3.4 in length of head in adults; gill rakers 4 or 5+1+12, the longest raker about equal to length of longest filament.

Caudal fin moderately forked; outline of rays of soft dorsal and anal fins slightly convex; free edge of preopercle serrated; scales ctenoid on body and head.

*Color in alcohol.*—Body and head light tan with six sharply defined brownish-black horizontal stripes extending from areas of the snout to the base of caudal fin; stripes located laterally on body about one-third width of lateral line scale taken from midbody area, and 5.5 to 7 in eye; width of area between stripes on lateral side of body  $1\frac{1}{2}$  to 2 times width of stripe; a dorsal stripe begins just posterior to interorbital area of midhead and extends dorsally to precurrent rays of caudal fin, dividing at origin of spinous dorsal and uniting at end of base of soft dorsal fin; a dorsolateral stripe extends from snout, dorsally, just touching dorsal margin of eye and anterior lateral line pores on body and passes posteriorly on dorsolateral portion of caudal peduncle; midbody stripe begins on tip of snout, passes through middle of eye and along midbody, extending almost to spot at base of caudal fin; a ventrolateral stripe extends from tip of lower jaw, along anterior portion of dentary, thence through upper jaw and just below eye, through base of pectoral fin and ventrolaterally to caudal base; another ventrolateral stripe passes from symphysis of lower jaw ventrally along inner edge of mandibular bones and lower edge of interopercle, passing just above base of pelvic fin and posteriorly near anal

base, uniting with stripe of opposite side at rear of anal base forming common ventral caudal peduncle stripe; a ventral stripe extends from the isthmus, just posterior of tip of lower jaw, touching inner branchiostegals of both sides, and on midbelly through bases of pelvics to vent; a conspicuous round, brownish-black spot at midbase of caudal fin, its diameter about five times in least depth of caudal peduncle; spot surrounded by a clear, nearly circular area, its diameter almost equal to the least depth of the caudal peduncle; stripes wider, more intense, and more sharply outlined on head; stripes taper very gradually from head to caudal peduncle, where they are less intense and have the least width; first two spines of spinous dorsal blackish, procurent and outer two developed caudal rays with some black pigment, remainder of median and paired fins nearly transparent.

*Range.*—Represented in the United States National Museum collections from the East Indies, and the Philippine, Society, Phoenix, Samoan, and Marshall Islands.



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